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INDUSTRIAL ENGINEERING IN EUROPE AND IN AMERICA.

IT is always instructive to hear what other people think about one, even though it be proverbial that listeners never hear any good of themselves. It may be wondered whether there is not a subtler meaning in this saying than that which is apparent on the surface. For if Bill Jones were to hear it said of himself that he was a splendid chap, energetic, hardworking, resourceful, and generally a paragon, to be feared by his enemies, envied by his rivals, and courted by his friends, Bill Jones might be tempted to sit back and say to himself that he might as well take things a bit easier, and trust to his normal energies to take him towards his goal with less effort. Such a result would be just what a rival would be very desirous of bringing about, and such a method might well be the only one by which that end could be achieved.

We think we shall be justified in acquitting Mr. Dwight T. Farnham of any intention of that kind. In a survey of European industrial conditions now before us, being a reprint from the transactions of the Society of Industrial Engineers, he warns American industry of what it has to apprehend from European and notably from British activities. No doubt it will be a salutary tonic to our kinsmen to be told that methods are in use in very large concerns in Europe, of which they have only recently announced themselves to be the originators. "I never knew what a desirable and healthy child Safety First was," says Mr. Farnham, "until I met his father in Italy, in Germany, and in England."

Well, we know it has been said, though we forget by whom, that an American thinks his country the finest in the world, and he will tell you so; while an Englishman thinks his country is the finest in the world, but refrains from mentioning the fact, because he thinks you must already be aware of it without being told. And salutary tonic though such news as Mr. Farnham has to give may be to the American nation, gratifying as it may be to our self-esteem, all is not well with industrial conditions in any part of Europe, and certainly not in Great Britain. What is lacking is not knowledge, not ability, not tools, not even reductions in wages, since wages are notoriously higher in America. It is the will to work. *Mr. Punch* sardonically hits the thing off when he shows Sir Alfred Mond calling a halt in the Government's housing programme by appearing at the window of an unfinished house and saying, "Stop work" to two bricklayers who are lounging and taking their ease, pipe in mouth, accepting their wages and not giving a fair day's work in return. The ca' canny policy of, among other unions, the A.E.U., who are said to fine a man heavily for doing more than is held to be a day's work, or for not absorbing all the time allotted to a job, in declining to be parties to a Whitley Council for the engineering industry, and in adopting a selfish view generally, is one of the factors that is playing havoc with British trade. The efforts of employers to make cuts in wages that cannot be warranted by the cost of living, as in the cases of coal and engineering, have the natural effect of increasing the distrustfulness with which labour re-

gards the employer class. It is the besetting sin of selfish narrow-mindedness that must be fought against and conquered before real and permanent progress can be made.

The lessons addressed by Mr. Farnham to his American friends ought to be taken to heart by British workers, whether employers or employed. Forget the words of praise, which will not do you any good, and think of the home truths about the work Germany is doing. Whatever any other nation can do, Britain can. Whatever any other nation is doing, Britain must do something better. If industry in this country will but do itself justice, we need have no fear for the future.

The Society of Industrial Engineers, of which Mr. Farnham is a vice-president, favours us with a brochure descriptive of its activities, which are numerous, and cover the whole ground of the engineering industry. The scope of this society may perhaps be best appreciated by a statement of its avowed objects. These are:—

I.—To furnish a medium for bringing out original contributions to the science of management.

II.—To provide an organisation through which persons who are applying scientific methods to the solution of the problems of production and distribution may exchange views and co-ordinate their efforts.

III.—To co-operate with other societies.

IV.—To codify and standardise professional principles and practice.

V.—To develop the professional standards of the industrial engineer.

VI.—To promote efficient energy-conserving management.

VII.—To enhance the efficiency and prosperity of American industry.

To advance these laudable objects, two national conventions are held annually, at widely separated industrial centres. At these conventions, from 1,000 to 1,800 industrial executives are present, together with engineers and educators from all parts of the world. They have, in addition, monthly district meetings in the larger industrial centres, and issue special publications as well as their regular *Proceedings*. There is a Speakers' Bureau, the duty of which is "to furnish industrial organisations with competent speakers on various subjects of general and special interest, and with programmes of subjects selected with a view to the promotion of efficiency in industry." There is a reference library in Chicago; and, last but not least, there are nine committees, dealing with research, education, finance, promotion, fatigue elimination, publication, programme, membership, and executive matters.

Here is an example that ought to be followed by industrial engineers in this country. We have lately seen the first issue of the *Journal* of a Society which exists in Great Britain, whose objects are, or ought to be, somewhat similar to those enumerated above. The Society referred to was founded about three or four years ago to promote the interests of those engaged in technical pursuits, but up to the present little has been heard of its activities. We do not wish to be thought sarcastic when we congratulate the Society of Technical Engineers on having at last issued something over its own name, which can be read by the ordinary busy engineer without having to make tedious reference to a lot of other documents, which he may or may not have kept, but which are almost certain not to be at hand when wanted. We have not been invited to express any views on this society, as we have by the American Society to which reference has been made, but we think this a fitting occasion to observe that the advice once given against the hiding of a light under a bushel is worth following, not merely that the light may shine before men, but that it may not extinguish itself.

It may be true, as some think, that the Americans are not so far in advance of us as some Americans would have us believe. Mr. Farnham is almost certainly right in his observations, and probably also in the deductions to be drawn from them. But this is no time for self-complacency, or for thinking other people ought to be aware of our good qualities, or for anything but a spirit of real hard work, and a determination to get on with the job that lies before us.

Reconstitution of the National Council.

It will be remembered that some little time ago there was much discussion both in public and private on the question whether the members of the National Joint Council for the Electricity Supply Industry should be elected direct by the thirteen District Councils, instead of by the employers' associations. The proposal was for the time being negatived. Now, however, the National Council itself, or rather at the moment the employers' side, has decided that this side shall be enlarged straightway to 26 members (instead of 12 as at present) and that each District Council shall nominate thereto one municipal and one company representative. From the views originally expressed by the District Councils, we may take it that the proposal will meet with practically universal approval. It will certainly weld the Whitley system, as adapted to the electricity supply industry, into a more thoroughly systematised and organic whole.

An interesting point, and one which can hardly be called finally settled, is what the Trade Unions will do with regard to their side of the National Council. Their view as expressed in the National Council is that they are satisfied with their present mode of election—and apparently with their present total of twelve. (The inequality numerically of the two sides is immaterial, as all resolutions must be carried by a majority on each side independently.) But the view of the present Trade-Union members of the National Council is not necessarily the view of the various local branches of the Unions. Some of these seem certainly in favour of the members being elected from the Trade-Union members of the District Councils. What the general feeling is remains to be seen. The question touches on one of those smouldering controversies within Trade-Union circles—namely, the movement to throw more power into the hands of the rank-and-file as opposed to concentrating it in the hands of a small Executive. For the Trade-Union members of the National Council to be nominated by the local branches would obviously score a point for the democratic party. Anyhow, this is a matter for the Trade Unions themselves to settle.

This method of electing the National Council is, of course, contrary to the Whitley Reports, which lay it down as essential that the employers' side must be nominated direct by employers' associations. But however cogent this recommendation may be for partially unorganised industries, the electricity supply industry is so highly organised as to entitle it to treat itself as an exception, especially on a practically unanimous decision of the whole.

The French Manufacturing Industry.

According to a French contemporary, the reports of the big firms manufacturing electrical machinery show that this industry is in a privileged situation. Despite the general crisis, the order books of the firms continue to be well stocked, and the reduced value of the turnover is relatively slight as compared with 1920. This favourable situation is due partly to the fact that quite a number of hydro-electric works are in course of erection, which work extends over a considerable period. In addition, the industrial reconstruction of the devastated districts has rendered necessary the preparation of a special programme for the electrification of the industries in the North, and steam power generating stations are being constructed or extended in these regions in the vicinity of coal mines. The supply companies also report an enormous expansion in consumption, as contrasted with last year, and this is leading to a large demand for electrical plant and materials.

Copper Replacing Aluminium in Germany.

As was mentioned in this journal some time ago, the production of aluminium in Germany was greatly developed during the years of war, but the use of the metal is said no longer to command the interest which is desirable for the advancement of the industry. The principal works are the property of the Reich. These are those of the United Aluminium Works Co. at Lauta, with an output capacity of 12,000 tons per annum, the Horrem works and the Bitterfeld works, each with a capacity of 3,000 tons, and the Erft works, having a productive capacity of 12,000 tons. The Lauta works is based upon power raised from lignite, while the Inn works, which is not yet producing, was erected for operation by power from hydro-electric works. Although the Lauta works was established for the working-up of clay won in the vicinity, bauxite of non-German origin is mainly used. Hitherto the German bauxite mines have not been able greatly to develop because the native product is inferior to foreign bauxite, and the latter is offered at comparatively low prices at present. The producers of aluminium have to contend with great difficulties in disposing of the output, as various industries are unwilling to work up the metal. Thus, for instance, high-pressure transmission lines are chiefly being made of foreign copper despite the fact that overhead conductors of aluminium have been made for many years past in the United States. Since the middle of May, 1921, 18,000 tons of American copper has been imported into Germany, whereas the stocks of aluminium amount to 5,000 tons, for which no home market can be found owing to the large imports of copper.

Indian Government Contracts.

As a result of a consideration of the reports presented late last year by the Stores Committee which was appointed to examine the question of the purchase of Indian Government stores, the Government of India proposes to revise the system hitherto in use, and for this purpose a series of rules has been prepared for the guidance of the local governments, although the rules have not yet been brought into operation, pending the establishment of an organisation by three officials whose appointment has been sanctioned by the Secretary of State. A circular has been issued to the local governments informing them of the proposed changes, and copies of the letter and of the text of the projected rules were recently received by the Board of Trade from India, and were set forth in part in the *Board of Trade Journal*. The three principal rules relate respectively to the encouragement of Indian manufacture, the production in India of manufactures from imported materials, and articles not manufactured in India.

The third rule is certainly the most important from the British export point of view, as it lays down the principle that stores imported into India for the public service are to be purchased through the London Stores Department, except in certain specified cases, to which additions may be made subsequently as experience is gained. The rule states that articles not made in India should be procured by indent upon the Stores Department, London, except in the following cases: (*a*) When the articles are already in India or are on their way out, and their price and quality are not unfavourable as compared with those at which similar articles could be obtained through the London Stores Department. When the total value of the articles required is trifling it is generally desirable to purchase them locally; (*b*) in the case of important construction works placed out on contract, articles not made in India and required for the carrying out of such works may be supplied by the contracting firm provided that the firm is included in the list of those approved by the Government, and the materials are subject to the current specifications and tests prescribed by the Government; (*c*) plant and machinery and component parts thereof may be purchased from branches established in India of British manufacturing firms, whose names are on the list of the London Stores Department and are approved by the Chief Controller of Stores, India, provided that the following conditions are observed: (1) That the purchase is to be made by the Chief Controller of Stores, India, or by a qualified engineer directly responsible to the Government; (2) that the plant and machinery are to be of standard patterns such as are ordinarily constructed by the firm; (3) that the branch firm maintains a staff of expert mechanics capable when so required of erecting and repairing the plant and machinery; (4) that the actual cost price (exclusive of the cost of erection) is as low as that at which the articles of the same make can be supplied by the London Stores Department; (5) that the cost under any one order or detailed estimate in respect of any one type of standard plant or machinery is not to exceed 50,000 rupees; (6) that when test or inspection is necessary, arrangements are to be made for the work to be carried out by the London stores department. It is further provided that branch firms may be held to include approved selling agents who are also in a position to render the same kind of technical assistance in India as the actual branches of the firms. As to the purchase of plant and machinery from the branches of British firms, the view of the Government of India is that the establishment of such branches will encourage the development of local manufacture, and is indeed the only practical means of introducing certain specialised forms of manufacture into the country.

Coming to consider the remaining two rules, it has to be noted that the explanatory memorandum accompanying them states that it is the policy of the Government of India to make purchases of stores for the public service so as to encourage the industries of the country as far as is consistent with economy and efficiency. But as the Local Governments are practically forbidden to pay more for locally-made articles than the market prices, or to grant special bounties, and as indigenous stores can only be purchased by them at a "negligible excess cost," it is not easy to understand where the preference given by the first rule comes in. The second rule, too, appears to be even less encouraging to Indian industries. It deals with the preference to be granted to articles wholly or partly manufactured in India from imported materials, but it is stated not only that the price must be as low as that at which articles of similar quality can be obtained from the London Stores Department, but also that this condition is less favourable than the first rule with its preference amounting to a "negligible excess cost." The three rules clearly demonstrate that the interests of indigenous manufacturers are not to be financially assisted at the cost of the general body of the taxpayers.

The London Inquiry.

Last Friday, as foreshadowed by Sir John Snell, the inquiry in connection with the London and Home Counties Area was brought to its conclusion, having occupied a total of 26 days in a period of seven weeks—and at what a cost! In view of the importance of this inquiry, affecting a population of some eight millions, and a capital of 32 millions sterling already invested in electricity supply undertakings, with generating plant aggregating some 400,000 kW, we have felt it to be our duty to report the proceedings as fully as space permitted, and have in fact devoted nearly 53 columns to this matter. Whether the time of those concerned in the inquiry was utilised to the best advantage remains to be seen; we hope to comment on the procedure somewhat fully in a later issue—but it will be realised that if our condensed report runs to some 50,000 words, the mass of information with which the Commissioners have to deal, including numerous written statements, tabulated data, and statistics must be colossal. We trust that their health will not suffer under the strain which has been imposed upon them, and that they will be able to find a satisfactory solution to this exceptionally important problem.

SUBMARINE CABLE TESTS.

By J. RYMER-JONES.

The following article deals with methods of measuring the C.R. and D.R. of a laid submarine cable while it is subjected to frequent "earth," or "tramway," currents of varying strength and polarity.

Measuring the D.R.—By direct deflection:—

In spite of 10.5 n.m. of earth-cable-core at the testing end, the cable to which the writer refers is almost incessantly traversed by earth-currents of changing polarity due to electric tramway systems, causing the spot of light to make excursions all over the galvanometer scale, sometimes as much as 300 divisions or more, on the wrong side of the zero position.

In consequence of this, the mean of the excursions during, say, the first five or ten minutes with the negative testing current could not compare respectively with the mean of the first five or ten minutes with the positive current, when earth currents affected the insulation readings.

In making a D.R. test, when earth currents are strong and of unequal duration, *time* is a very important factor; and, therefore, the writer prefers a special test sheet where every minute for one hour, when testing with the negative current, and also every minute for one hour with the positive current, is divided up into 12 vertical and parallel columns, for every five seconds, to be used in case the earth currents are very unsteady.

After putting the negative current to the cable through a dead-beat galvanometer, the electrician mentions the particular moment to his assistant, who has the test sheet and a watch in front of him, and who, at exactly, say, 5-seconds interval, says in a loud voice, "Now"; and the electrician immediately calls out the deflection, observed at that moment, to be recorded by the assistant. The same procedure is gone through at exactly every succeeding five seconds for one full hour.

After this the cable is wholly discharged, and a similar test of one hour's duration is made with the reverse current.

It is a long and tedious test, but gives remarkable comparable *mean* results between the negative and positive insulations if, in each case, the test is continued for one hour.

When the E.C.'s do not change very frequently, and the deflections are consequently much more regular, readings at intervals of only 15 seconds, or more, will be sufficient.

Formula to obtain the mean deflection with either the negative or positive testing current:—

Add together all the five-second readings, if any, on the *minus* side of the scale zero during, say, 30 minutes, and subtract their sum from the sum of all the five-second readings on the *plus* side of the scale zero; then divide the result by the sum of all the plus and minus five-second readings.

This will give an approximate mean scale deflection during the first 30 minutes, which should be compared with the mean deflection during the first 30 minutes with the reverse current. Similarly, the mean of all the five-second readings, obtained in the same way, during the second 30 minutes with the negative current should compare, more or less satisfactorily, with the mean deflection with the positive current, according as the earth currents are less or more irregular. If negligible, the mean readings should be exactly the same (for both the negative and positive currents) for the same period of time. If the E.C.'s are very strong and changeable in direction, the more prolonged the test readings, and the shorter the equal intervals of time between them—say, five seconds only—the more accurate will be the calculated D.R. value.

The accuracy of the result is due to the test being prolonged over many changes in the strength and polarity of the earth currents; and also to the very important influence on the *mean* observed deflection or the *time* during which the deflections remain in approximately the same positions on the scale. During a test continued for, say, one hour with the negative current, the E.C. will probably undergo as varied changes as during one hour with the reverse current.

It should, of course, be understood that the average deflection of, say, 30 minutes—or 60 minutes, as the case may be—will give the *average* D.R. of the first 30 minutes—or 60 minutes—and not for the thirtieth or sixtieth minute respectively.

If the electric tramway—in spite of the ten miles of earth-core-cable at the testing end—keeps the dead-beat galvanometer deflection rising and falling continuously, the foregoing method of *averages* is absolutely necessary in order to get even an approximately correct D.R. value.

It is of interest that when tests were made from the other end where there is only an earth-cable-core of 1.5 n.m., and no tramway disturbance, the insulation deflections were quite steady enough to dispense with elaborate methods of testing.

The writer had much the same experience with the San Francisco-Honolulu cable, the electric tramcars at the former end causing considerable disturbance; whereas final tests made at the Honolulu cable hut were often so free from any earth currents that, when about to start testing, the electrician had to assure himself that the cable was really connected to the testing apparatus. Hence the advantage, when such different conditions are known to exist, in making the final tests from the cable end least disturbed by earth currents.

C.R. by "Bridge" Test.—So great and frequent were the reversals in the earth currents that no attention could generally be paid to adjusting the "tens" and "units" on the bridge. The method adopted was simply to reverse both battery and galvanometer reversing-keys as nearly as possible at the same moment (*), so that *too much* or *too little* would always come on the same side of the scale-zero and confusion on this account be avoided.

The electrician has merely to confine his attention to turning the hand-knobs of the sliding contacts of the hundreds and thousands, and to keeping his eye on *the spot of light*, while quickly sweeping it along the scale to the zero to improve the balance.

After calling out to his assistant the approximate bridge reading, the electrician very quickly indeed switches over both of the R-J(*) reversing keys, and again brings the spot of light towards zero—not paying too much attention to a few divisions of error—and calls out any important change in the resistance to be recorded.

In this way he can obtain a "series" of, say, 20 readings, the mean of which, if very quickly done, will give an approximately correct value. Three or four *series* are sometimes desirable. There is no doubt a certain amount of reliability resulting from a large number of reversals, but there is greater certainty still in judiciously selecting any series which most closely agree with each other.

It is necessary to be very quick in reversing both the battery and galvanometer, otherwise the bridge reading with one polarity may have little relation with the resistance measured with the other battery pole.

* The Rymer-Jones reversers—both for the battery and galvanometer—are found convenient if connected up so that their handles point in the same direction; and a small fraction of a second suffices to switch both over for a reversal.

JOINT ELECTRICITY AUTHORITIES.

London and Home Counties Inquiry.

(*Concluded from page* 143.)

On Wednesday, July 27th, Mr. TYLER continued his speech for the railway companies, and reiterated the willingness of the companies to co-operate in every way possible in the development of electricity supply in the Metropolitan area. One important means to that end would be representation upon the Joint Authority. The schemes before the Commissioners, however, treated the railway companies solely as large consumers, but he submitted that it was clearly the intention of the Electric Supply Committee of the Board of Trade that the railway companies should have representation as railway companies. Matters of wayleaves, feeder routes, &c., would have to be discussed by the Joint Authority, and the railway companies could offer valuable technical assistance. The railway companies thought that the administrative expenses of the Joint Authority should not be spread over all those represented on the Joint Authority, but only amongst those who would benefit in the matter of supply. Mr. Tyler said the railway companies had no objection to contributing to the administrative expenses when they became consumers of the Joint Authority.

Sir HARRY HAWARD said this meant the railway companies wished to be placed in a better position than if they erected their own power stations, because preliminary expenses must be incurred before revenue was earned.

Mr. TYLER, in concluding, asked for two railway representatives to be appointed by the Railway Association or by the Commissioners on the representation of the Railway Association. So far as the supply to railways was concerned, the schemes proposed 50 cycles, but he was instructed that 25 cycles involved less difficulty for railway purposes.

Sir JOHN SNELL said that nobody would suggest supplying a railway on a system which involved a change from 50 to 25 cycles.

Sir HERBERT NIELD, K.C., speaking on behalf of the Surrey County Council, asked that counties should not be split up by any scheme devised. As the schemes stood, there was no immediate prospect of many parts of the county getting a supply of electricity. Indeed, Barnes and Kingston were the only two stations which it was proposed to link up in the first stage. On the question of representation, he urged direct representation for the county. Dealing with some of the details of the Conference scheme, Sir Herbert drew attention to the clause giving the Joint Authority power to oppose Bills in Parliament. There should be no power to any authority now to promote Bills in Parliament or to oppose them without the consent of the Commissioners. Another matter raised was the possibility of territorial encroachment by the L.C.C. into the home counties. Only quite recently electricity supply had been given as one of the reasons for a greater County of London area. Coming to the opposition of Hertfordshire, counsel said the case for exclusion was even stronger than that of Surrey, because there was an intervening county between London and Hertfordshire, which made the likelihood of Hertfordshire getting a supply from the Joint Authority even more remote. His general reasons for not wishing to be included were those already put forward for Surrey, and if Hertfordshire were included then there must be direct representation. It was part of the reconstruction proposals of the Government, but contrast the conditions then with what was the position to-day. The Minister who promoted the Bill had fallen, and the Ministry of Transport, to which the administration of the Act was entrusted, would disappear very shortly. The financial conditions of the country, too, were a serious factor in considering large schemes of this kind, and for all these reasons he hoped the Commissioners would see fit to exclude Hertfordshire from this scheme, Surrey would like an opportunity of putting proposals forward if the Commissioners desired it, as an alternative to being included in the larger area.

Mr. DONALD, on behalf of the East London scheme, summed up the position. First of all there was the unfortunate limitation of the powers of the Commissioners to apply driving force to any such schemes as those put forward now. The real powers of the Commissioners could not be made use of at the present time, but were held in reserve until the various undertakings came to the Commissioners for extensions of their plant, should such undertakings not be willing to come under the Joint Authority. The real powers of the Commissioners were under Section 19 of the Act, which provided for neighbouring authorities giving mutual assistance. It seemed to him that at the present time it would be impossible to set up one Authority for the whole of the delimited area which would meet with the approval of both companies and local authorities. Having briefly reviewed the past history of electricity supply legislation since 1882, Mr. Donald suggested that the fact that the L.C.C. proposed in 1914, after only having had the purchase powers over the London companies since 1908, to transfer them to another body, and now proposed to transfer them to a Joint Authority, had made the local authorities somewhat distrustful of the L.C.C. The local authorities of London had sold energy at a lower average price than the companies, and the lowest price anywhere in London was in the East of London. The local authorities' undertakings were in a sounder financial position than those of the companies. This difference in the financial position, he suggested, provided an insurmountable difficulty in forming a Joint Authority which could include both companies and local authorities. There was not a single authority which had expressed its willingness to join in the L.C.C. scheme. So far as the engineering scheme was concerned, he contended that no one scheme as put forward could accurately represent the ultimate financial working of the three proposals of the L.C.C., the Conference, and the Nine Companies, solely because the difference in the values of the company undertakings and the local authority undertakings, as he had indicated, had not been taken into account.

Mr. DONALD continued his speech on Thursday, and dealt with the question of subdividing the large area delimited by the Commissioners into smaller areas, as suggested by the East London scheme. He called in aid in this connection the evidence of Sir Alexander Kennedy, Mr. Rider, and Mr. Merz, as indicating that development would take place more efficiently in smaller areas than that taken in the L.C.C. scheme. As regarded the advisability of building capital stations at once or postponing them, his clients favoured the former course. To elect a large Central Authority to take over the control of the generating stations in the larger area after the manner proposed in the L.C.C. and Conference schemes, would be to eliminate the very factor which would lead to a supply of cheap electricity being given, because one of the preliminaries to any such transfer was a guarantee that power would be supplied to the undertakers at a figure not less than the present generating costs. In the bulk of cases where public control had failed, it was due to the fact that the problem was an extremely complex one, and too much was attempted to be done under one control. That was a result to be feared if the larger area was adopted by the Commissioners. Criticising the figures in the engineers' report, Mr. Donald suggested that credit had been taken for certain existing plant as regards generation, but nothing had been allowed for capital charges on that plant, the assumption being that the loan had been paid off at the period to which the figures related. His contention was that in this event something should be allowed for capital charges, otherwise the cost of generation was much lower than would be the case in a very short time afterwards when the plant must fall completely out of use. At the same time, he denied the possibility of plant amounting to 440,000 kW, being capable of use to the extent shown.

Sir JOHN SNELL assured Mr. Donald that the Commissioners would very carefully consider that point.

Mr. DONALD, concluding his speech, urged for the delimitation of workable areas, and not a larger and theoretically perfect area.

Mr. KENNEDY, for the nine companies, said that so far as the technical scheme was concerned, he claimed that it was by far the best scheme that had been put forward yet, provided the proper administrative means were found for giving effect to it. He was desired to refute some of the opinions expressed by Mr. Merz. In particular, he denied that the engineers of these schemes had taken up an obstructive attitude, as Mr. Merz had suggested, or that they had been controlled by their clients in the views given. The whole Committee of Engineers regarded these statements not only as a reflection on their professional skill, but almost upon their *bona-fides*, and he wished to bring that strongly to the Commissioners' notice.

Sir JOHN SNELL said it could be taken that none of the Commissioners would for a moment doubt the *bona-fides* of the Committee of Engineers.

Referring to the position as between the nine companies and the County Co., about which an announcement would be made later, Mr. KENNEDY said that any agreement come to would not abandon the Beckton site for a power station. It was believed that a power station would be required at Beckton as well as at Barking. Again, a defect in the technical scheme of Poplar was the proposal to erect a power station at Dagenham, because the transmission costs would be greater from there than from Beckton or Barking. So far as the railway load was concerned, the impression given to the engineers of the schemes before the inquiry was that the railway companies did not intend to take a supply from a Joint Authority, but that attitude had been modified. His clients were quite willing to take into consideration the railway supply now. If, for instance, the Great Eastern Co. could say that it would want 40,000 kW in a few years' time, the Charing Cross Co. would put down that amount of plant at Bow. Similarly, if the railway companies indicated that railway electrification would be put in hand within the next few years involving 100,000 kW, then his engineers would advise the companies or the Joint Authority to erect a capital station at once. To do this, they would want an assurance that they would get the business.

Sir JOHN SNELL said there was an essential difference between this and the view of the County of London companies, which was prepared to erect a station at once primarily for its own area, but also for the railway load.

Mr. KENNEDY said the Joint Authority or the companies would not put up a station costing £2,000,000 without some reasonable assurance that the railway companies would take supply. However, he was certain that the railway companies and the Joint Authority would come to an arrangement.

Dealing with the area, Mr. Kennedy frankly said it was

thought by Sir Alexander Kennedy and Mr. Partridge that no good purpose would be served by including a large area outside which could not be supplied for some years. His clients viewed with anxiety the choice of an area which might place an undue burden on the Joint Authority, because pressure might be placed upon the Joint Authority to give supply in areas involving long transmission lines, the cost of which would react upon the cost of the general supply.

Discussing the constitution of the Joint Authority, Mr. Kennedy said he did not think the companies would object to representation of the County Councils outside London provided local authorities in the county areas did not have representation also. His clients thought that those who found the money should have the largest proportion of the representation.

At this point Mr. Kennedy broke off to make a statement as to an agreement come to with the County of London Co. He said that his clients believed that the proposed Barking station was for the needs of the County Co.'s statutory obligations only. They felt it would not be proper for them in any way to hamper the County Co. in this matter. His clients agreed that the Barking proposal, as outlined, did not necessarily conflict with their scheme.

Mr. Morse, for the County of London Co., said he was instructed to agree with this statement, and to state that his company was prepared to co-operate with Mr. Kennedy's clients in every possible way.

Mr. Kennedy then went on to deal with the suggested transfer of the companies' generating stations, saying it was doubtful whether this could be done without further Parliamentary sanction.

Mr. Craig Henderson said he was going to argue that under the L.C.C. scheme, further Parliamentary powers would not be necessary.

Mr. Kennedy said that under the Act of 1908, the sale could only take place to the L.C.C., and to the Joint Authority.

Mr. Booth said the Act of 1908 referred to the whole undertaking, but he did not believe there was anything to prevent a company selling its generating station to anybody who was authorised to buy.

Mr. Kennedy, dealing with the control, submitted that it would be *ultra vires* for the Commissioners to impose a control of the undertakings as proposed in Clause 14 of the L.C.C. scheme. The Act of 1919 said that no undertaking should be transferred without the consent of the undertaker, and Clause 14 of the L.C.C. scheme conflicted with this.

Coming to the terms of purchase, Mr. Kennedy challenged the right of the local authorities to be purchased on the same terms as the companies, because in the case of the local authorities it was merely a change of ownership from one public authority to another, whereas in the case of the companies they would, by transferring their generating stations now, be giving up something with a cash value in 1931 more than the price now being asked. This must have the result of reducing the price of electricity. As to the alternative method of dealing with the value of the companies' stations by arbitration, instead of cost less depreciation, the companies did not see their way to give up this option, because there might be cases in which the true value could be arrived at on the cost basis.

Questions by the Commissioners indicated that they did not altogether like this decision, because it was pointed out that the alternative completely threw over the main principle of cost less depreciation.

Mr. Kennedy said he would advise his clients carefully to consider this question. In conclusion, Mr. Kennedy claimed for his scheme that it was the only one for which the capital for the preliminary work was assured.

Mr. Turner followed for the Conference of Local Authorities scheme. After pointing out the chief differences between the various schemes, he stated reasons why there should not be such a small area as that proposed by the East London scheme, nor should an important industrial area like this be separated from the remainder of London. On the question of capital stations, his own scheme was flexible in that a capital station could be erected the moment conditions were favourable as regarded load and conditions of finance.

Sir John Snell said that since the Conference estimates were prepared the cost of money and the cost of plant had fallen. Did these facts cause Mr. Turner's clients to persist in the policy of interlinking and not erecting a capital station at once.

Mr. Turner said he would rather consult his clients and answer the point later.

Continuing, counsel discussed Mr. Merz's evidence at some length, and argued that the position of London was so unique that past experience of what had been done elsewhere was no guide.

On Friday, July 29th, Mr. Turner, continuing his speech, referred to the point raised by the Chairman on the previous evening regarding the reduction of cost of money and plant. He said it had always been the policy of the Conference that the moment plant became cheaper and the conditions generally were more suitable, they would be willing to consider the erection of a capital station. That did not represent any change of policy on the part of the Conference, because its case had been all along that capital stations would be erected the moment conditions permitted.

Continuing with his general speech, Mr. Turner criticised Mr. Merz's view that the dominating factor in the supply of electricity was the cost of coal. The proportion of the total costs attributable to coal was 20 per cent., whereas capital charges represented 50 per cent., and his case was that the County Co.'s Barking station would have to bear higher capital charges than a station erected by the Joint Authority. On the question of railway supply, counsel took up the same attitude as that adopted by Mr. Kennedy.

During the course of arguments with regard to the administration of the scheme, Mr. Turner said the attitude of the Conference was against acquisition of the generating stations by the Joint Authority until a capital station was built. Meantime, there should be control of the existing stations.

Sir John Snell said that in the event of its being found possible to erect a capital station at once, that would mean acquisition at once. Therefore, why put off dealing with acquisition in the scheme?

Mr. Turner said that some of the authorities in the scheme were not at present willing to part with their stations, but the Conference hoped that time would bring them to change their view.

Sir John Snell asked if the 34 authorities in the Conference would accept an order by the Commissioners providing for transfer.

Mr. Turner thought they would, subject to an appeal to the Commissioners, although he could not pledge the individual authorities to part with their stations on any terms. Commenting on the East London scheme, Mr. Turner said the view of the Conference was that it would be an unwise proceeding to tie the hands of the Joint Authority by saying that it should appoint a District Committee for the East London area. From this Mr. Turner passed to the financial proposals, and said that the Conference, through its individual constituents, was willing to provide the £1,050,000 necessary at the commencement, on the security of the rates of their areas.

The most difficult question of all was the terms upon which undertakings or power stations should be acquired. The dominating factor in this was that nothing could be done except by agreement. At the moment he understood that the terms of acquiring the Companies' undertakings were a matter of negotiation between the L.C.C. and the Companies, but it must be remembered that those terms could only apply to the Companies concerned with the Companies' scheme. Moreover, he contended that these terms, in any case, should be fair and equitable, *vis-a-vis* the local authorities' undertakings. It had never been suggested that the terms of purchase of companies' and local authorities' power stations should be identical, but the case of the local authorities was that the terms should be on the same basis and no less liberal. As to the terms of purchase of the Companies' generating stations coincident with an extension of tenure, which latter the Executive of the Conference had opposed in a resolution, Mr. Turner said that a full meeting of the Conference had now been held reiterating the view that the extension of tenure should not be made a condition of transferring the generating stations before 1931, and expressing the view that the Companies would not be injured if they were guaranteed electricity at a price not higher than the Companies could generate at. Subject to this, the Conference did not object in principle to an extension of tenure of the distribution rights of the Companies on terms to be arranged in each case. This resolution had been passed by the full Conference absolutely unanimously. As to the basis to be taken for depreciating the plant of the Companies in the event of purchase on the basis of cost less depreciation, Mr. Turner said the Companies had selected the Income Tax basis, because it was the most favourable to them. As showing the difference effected by the difference in the method of calculating the depreciation, counsel said that on the basis of the L.C.C. method of depreciation, the value of the Companies' undertakings in 1921 would be 6.72 millions sterling; on the local authorities basis of depreciation it would be 5.5 millions, but on the Companies' basis, or the Income Tax basis, it would be 8.2 millions sterling. Transferring those figures to cost per unit, on the basis of 6½ per cent. over an output of 1,000 million units, it would be seen that the Companies' valuation would add an extra .03d. per unit to what it would be under the L.C.C. basis, or .06d. per unit over the Conference basis, whilst if the local authorities' generating stations were transferred on the basis proposed by the Companies for their stations, it would add another .06d. per unit to the cost, or a total of .12d. per unit over the whole area.

The next point dealt with was representation on the Joint Authority. Mr. Turner suggested that if the smaller authorities were willing to be represented by the Counties, then the Counties should have one each. He also proposed that the Port of London Authority should have one, the railways one, other larger consumers one, and labour one. That would have the effect of increasing the number by one and making the total number the same as in the L.C.C. scheme. At the same time, he hoped to convince the L.C.C. that it could do with a smaller representation than the three members proposed in the Conference scheme; indeed, he rather thought that the L.C.C. would achieve its real object more effectively if it had no representation at all. It would be better for a large body like the L.C.C. to remain outside the Joint Authority, in order that it could bring pressure to bear in the interests of the consumer. The Conference certainly strongly resented the proposal of the Companies that representation should be on the basis of financial assistance and the voting power dependent on the amount of money provided.

Before Mr. Henderson began his speech for the L.C.C., Sir John Snell said it might interest the parties to know that he had reason to believe that the Ministry of Transport would reintroduce the Electricity Supply Bill (No. 2) next session, and endeavour to secure its passage.

Mr. Craig Henderson then made the final speech of the Inquiry. He said the area delimited by the Commissioners was a proper area, and the test of it was the attitude one took towards the power companies whose areas were adjacent to London. The Electricity Act of 1919 clearly intended that power companies should be included in the area of a Joint Electricity Authority, because the powers to supply were expressly limited in the areas of power companies. Therefore Sir James Devonshire's objection to being included in a Joint Authority's area was an objection to the Commissioners' giving effect to Clause 12 of the Act of 1919. Moreover, before a Joint Authority could give a supply in a power company's area, the consent of the power company must be obtained, and there was an appeal to the Commissioners if the power company objected. Then the Commissioners would have to consider the terms upon which the Joint Authority was offering to supply. Therefore Sir James Devonshire's objection was one of principle and not because of fear of competition. As to the advantage which the power companies would derive from the scheme, he contended that quite apart from receiving a supply from a capital station, the linking-up of the power companies' stations would benefit them enormously. Increased sales must follow for the power companies, which should result in cheapening the supply with an increased demand. The two Willesden power stations were an integral part of the main load in London, and could not be left out of any consideration of the problem. If, therefore, the parts of the power companies' areas were taken in, the logical course was to take in the whole of the area, and that was what the Commissioners had done. He thought the Port of London Authority had made out a case for separate representation. Passing to the estimates, counsel said they had been prepared at a time when money was dear. Since the Inquiry began, the bank rate had fallen twice, and therefore if his estimates were too high on the old basis, it would be possible for a Joint Authority to go ahead at once, and more cheaply than a company. On the other hand, he put it that if the capital charges owing to the cost of money and plant were 40 per cent. of the total, then the time had not come to erect capital stations. Mr. Merz could not have it both ways. When considering what Mr. Merz said, they must remember that he was an engineer, but much of his evidence was that of a commercial man out to get orders, and when a man gave evidence which rightly did not come within his province, they were entitled to discount that evidence. It was in this category that he placed Mr. Merz's evidence with regard to building capital stations far in advance of the railway load. Mr. Merz was not the business manager of the County of London Co., but when they read the evidence before the House of Lords Committee dealing with the County of London Co.'s Bill a few days ago, Sir Harry Renwick, the managing director of the company, said that he would cater for the railway load if he got a contract, and that was the very thing which Mr. Merz had criticised the L.C.C. for doing. No prudent business man would do otherwise. It would be the duty of the Joint Authority to erect capital power stations as soon as possible, but only when it could be shown that a saving in the cost of supply could be effected. The immediate erection of a capital station would be all to the interest of the Joint Authority, because that would get rid of all the difficulties of purchasing existing stations and give control over the whole area at once. In effect, therefore, both the L.C.C. and the objectors were following the same path, but the objectors were paying less regard to the financial conditions than the L.C.C.

Sir John Snell asked whether, assuming the reduced cost of plant and money made the resultant cost of energy cheaper than was shown in the estimate, the Joint Authority would spend the extra capital compared with the amount required for linking-up during the past few years.

Mr. Henderson said the Joint Authority would certainly go ahead in that case, because of the cheaper supply of energy resulting, but the extra capital expenditure would, of course, be incurred in stages. That was the policy the L.C.C. was prepared to advocate. It was anxious to spend the capital as soon as it could be done with advantage. As some guide to the financial conditions to-day, counsel mentioned the issue of capital of the Shropshire, Worcestershire & Staffordshire Electric Power Co. at 7½ per cent., the issue price being 97, making the total interest 8 per cent.

Contrasting the evidence of the L.C.C. and the County of London Company, Mr. Henderson said that the Company had the idea of "jumping the claim" in order to get a station at Barking in advance of the general scheme. There had not been put forward any witness who was an executive officer of the Company, and no details of the Barking proposal had been placed before the Commissioners.

Sir John Snell mentioned that the Commissioners had laid the limitations on the County Co.'s evidence.

Mr. Henderson agreed, and said he regretted it, although he did not complain.

Continuing, counsel urged the Commissioners not to do as the East London scheme asked, and split up the area or compel the Joint Authority to appoint District Committees. Moreover, the East London scheme would perpetuate the old antagonism between companies and local authorities which was dying out, and he hoped the Commissioners would be able to kill it for all time.

Turning to the proposal of the Nine Companies, Mr. Henderson said the L.C.C. was in favour of the leasing scheme, but he doubted whether it could be done without further statutory authority. Apart from this, however, there were difficulties in arriving at the terms of acquisition, and here the L.C.C. and the Nine Companies differed from Mr. Turner for the Conference scheme. He did not know now what the wish of the Conference was on this matter, because the resolution passed by the full Conference apparently objected to the extension of tenure and then agreed to it in principle. The position as he saw it was that the London Companies had a perpetual tenure subject to the option of the L.C.C. to purchase at certain intervals. It was not bound to exercise that option, and there was nothing to prevent it entering into a bargain with the Companies that the option would not be exercised for 60 years if the Companies would do something, viz., transfer the generating stations.

Mr. Sydney Morse said it had frequently been pointed out that a body with a statutory option, such as the L.C.C. had here, could not, by entering into a bargain with the Companies, deprive its successors or the Joint Authority of the right to purchase.

Mr. Henderson disputed the point, but said this was a sample of the legal difficulties that had to be overcome. As to control, if there was to be a proper scheme, there must be such a control as would enable the central advisers to see that the undertakings were run in the general interest of the whole area. The L.C.C. scheme provided for that control, and he certainly objected to any scheme where the representation on the Joint Authority was based on financial support. As to County Council representation, that was the original intention of the L.C.C., but the Statute said the undertakers should have representation, but if the local authority undertakers all agreed to representation by the County Councils, then it would considerably simplify matters. Concerning the administrative expenses, if the Commissioners thought the L.C.C. ought to contribute, that would not be a matter of difficulty.

Sir Herbert Nield joined with Mr. Henderson and the other parties in expressing thanks to the Commissioners and the Institution of Electrical Engineers.

Sir John Snell acknowledged these sentiments, and said that a decision would be given as soon as possible. The Commissioners hoped to deal with it without loss of time, because they appreciated that interests were suffering by want of knowledge of what was to be the line of development. In conclusion, Sir John referred to the use of the Institution building, and to the manner in which all the facilities of the Institution had been placed at the disposal of everyone concerned with the Inquiry, and expressed a wish that the thanks of the Commissioners should be conveyed to the Council of the Institution.

South-West Midlands Electricity District.

Birmingham Corporation and Shropshire, &c., Co.'s Joint Scheme.

The following is an abstract of a scheme for improving the existing organisation for the supply of electricity in certain parts of the Counties of Shropshire, Staffordshire, Warwickshire, and Worcestershire, that has been submitted to the Electricity Commissioners jointly by the Birmingham Corporation (Mr. R. A. Chattock being the city electrical engineer) and the Shropshire, Worcestershire & Staffordshire Electric Power Co. (of which Mr. J. T. H. Legge is chief engineer).

In view of the fact that 98 per cent. of the electricity at present generated by authorised undertakers in the district is generated by the Birmingham Corporation and the Shropshire, &c., Co., it is not deemed necessary to set up a Joint Electricity Authority. It is suggested that the orderly development of supply in the district can be dealt with more thoroughly and economically by pooling the resources of the existing large undertakings through the medium of an Advisory Committee, the Electricity Commissioners being the final arbiters.

No actual fusion of financial interests on the part of the undertakings is either practicable or desirable, but subject to this reservation, the desired end can best be attained by developing and co-ordinating the existing organisations. It would be the duty of the Advisory Committee, among other things, to consider and to make recommendations respecting: (*a*) The development of the capital stations; (*b*) the construction of main transmission lines, and (*c*) the manner in which existing power stations in the district should be dealt with.

It is not intended that there shall be any disturbance with regard to the distribution of electricity in the district, except by agreement. In the urban districts of Rowley Regis, Stourbridge, Lye, and Wollescote, the Shropshire, &c., Co.'s rights are exercisable only by consent of the Midland Electric Corporation for Power Distribution, Ltd., but the area of these urban districts is only 22¼ sq. miles, and the Shropshire, &c., Co. already has mains laid through these districts for supplying outside them, and now seeks the necessary authority to supply within this small portion of the provisionally determined district, but without interfering with the 50-period supply which the Midland Co. is now actually giving therein. In consideration for this (but not otherwise) the Shropshire, &c., Co. is prepared to relinquish its rights to supply 1,292

sq. miles of the northern portion of its area of supply in the Counties of Staffordshire and Shropshire.

The Worcester Corporation and the Redditch Urban District Council are each affording a 50-period supply within their respective areas, and there is no desire to vary the position of these authorities unless and until they are prepared to receive bulk supplies from the Shropshire, &c., Co. In the case of Redditch, the Shropshire, &c., Co. already possesses authority to supply power users and for other purposes on the premises of such consumers.

The Kidderminster and the Halesowen Companies are controlled by and take the whole of their supplies in bulk from the Shropshire, &c., Co., and the latter, under agreement dated December 31st, 1917, with the Midland Co., furnishes a supply to the system of tramways in the Black Country owned and operated by the companies constituting the Birmingham and Midland Tramways Joint Committee. Suitable provision to enable the Shropshire, &c., Co. to continue this tramway supply should be specified in the Order constituting the district.

The Shropshire, &c., Co. also requires protection for the 25-period supply to the Tipton Fuse Factory of Messrs. Harper, Sons & Bean, Ltd., which supply was commenced during the war, under the instructions of the Ministry of Munitions.

A modification of the district provisionally determined by the Electricity Commissioners * is desirable by the omission of the rural district of Atherstone and the parishes of Austrey, Newton Regis, Seckington, Shuttington, Amington, and Stony Delph, Bolehall and Glascote, Wilnecote, and Castle Liberty (all within the rural district of Tamworth) in the County of Warwickshire, indicated in the accompanying map, which also shows the positions of the stations and transmission lines. This portion of Warwickshire contains a number of collieries which already receive an a.c. 50-period supply from the Leicestershire & Warwickshire Electric Power Co., and it may be well that the supply to this area should continue to be served as at present.

The electricity supply in the district is to be administered in the following manner: The Birmingham Corporation shall be responsible for the electrical development of the City of Birmingham and that portion of the district situated in the County of Warwickshire, which latter shall by Order be transferred from the area of the power supply of the Leicestershire and Warwickshire Electric Power Co.

The Shropshire, &c., Co. shall be responsible for the development of the remainder of the district under the Shropshire, Worcestershire and Staffordshire Electric Power Acts, 1903 to 1919. The South-west Midlands District Electricity Committee shall consist of four members, two of whom shall represent the Birmingham Corporation electricity supply undertaking and two the Shropshire, Worcestershire & Staffordshire Electric Power Co. One of the members to be appointed by the Birmingham Corporation shall be a member of the Electricity Supply Committee, and the remaining member shall be the city electrical engineer of Birmingham for the time being. One of the members to be appointed by the Shropshire, &c., Co. shall be a member of the board of directors, and the remaining member shall be the chief electrical engineer for the time being of the company. Each member shall have one vote only on all matters.

The duties or functions of the committee shall not be delegated to any other body or persons as regards the whole or any portion of the district. The committee shall advise upon such matters as: The operating time-tables of the undertakings; the best load factor obtainable; conservation of fuel; proper return upon the capital moneys; the standardisation of systems; and regularising the supply. The committee shall also be responsible for making recommendations to its constituent authorities as to the expenditure of capital moneys on extensions, but it shall not be competent for the committee to incur any capital expenditure nor to borrow moneys for such purpose.

Existing undertakings shall not be transferred either in whole or in part to the committee. The Birmingham Corporation and the Shropshire, &c., Co. shall be responsible for the capital expenditure incurred by them respectively in the areas defined above, and the financial arrangements as to capital and revenue accounts shall continue on a separate basis as heretofore.

The portion of the district within the County of Warwick may be supplied in bulk by the Birmingham Corporation. The distribution of energy in the City of Birmingham shall continue to be dealt with by the Birmingham Corporation, and that in the Borough of Sutton Coldfield by the Corporation of Sutton Coldfield unless otherwise determined by agreement with the Birmingham Corporation.

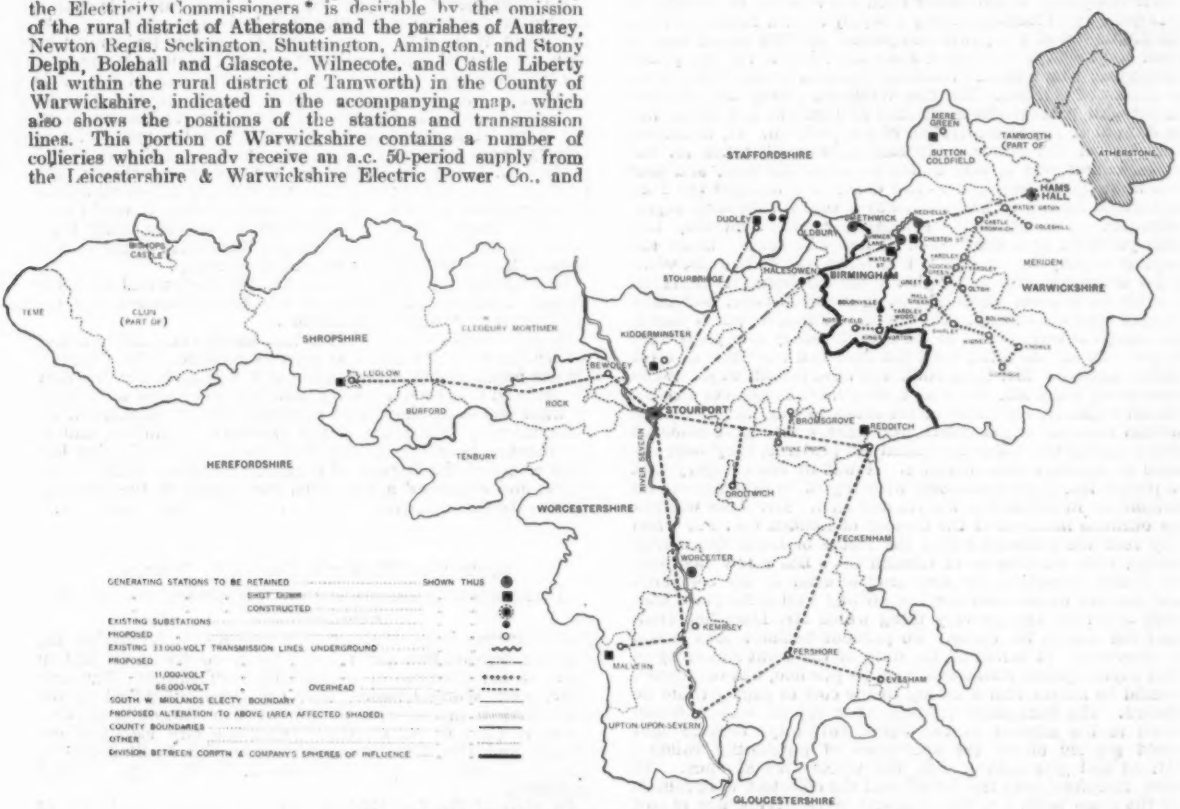


Fig. 1.—South-West Midlands Electricity District.

The distribution of energy in the rural districts of Meriden, Solihull, and the portion of Tamworth within the district shall be carried out by the local authorities for those areas, or may (by agreement) be undertaken by the Birmingham Corporation. In the latter event, the energy shall be supplied by the Corporation to consumers in such areas at the selling prices fixed for like supplies from time to time for consumers in the City of Birmingham, with a reasonable adjustment to cover any extra costs and contingencies involved. In that portion of the district within the Counties of Shropshire, Staffordshire, and Worcestershire the existing authorised undertakers may take supplies in bulk by agreement as may be required from, or they may transfer any portion of their undertakings to, the Shropshire, &c., Co.

The Birmingham Corporation and the Shropshire, &c., Co., respectively, shall exercise control of the generating stations and main transmission lines belonging to them in their respective portions of the district, and the responsibility for providing further interlinking main transmission lines shall be dealt with by the Corporation and the Shropshire, &c., Co. respectively, after consultation with the committee.

In the event of a local authority within any portion of the district for which the Shropshire, &c., Co. is responsible deciding to exercise purchase powers it may possess under any Act or Order, the Shropshire, &c., Co. shall supply electricity in bulk to such local authority. Authorised distributors shall accept supplies of 25-period 3-phase a.c., which shall be the standard system throughout the district, and those furnishing a supply within their own areas at the date on which

* Elec. Rev., Oct. 1st, 1920; p. 434.

this scheme becomes operative may continue as generating authorities in their own areas, so long as it is considered economically advisable, and until they are receiving full supplies in bulk from the capital stations of the Corporation or of the Shropshire, &c., Co. as the case may be.

The Birmingham Corporation and the Shropshire, &c., Co. have identical systems of supply which are linked together at the present time, and a further link of substantial capacity for mutual interchange of supply will be installed. The main underground transmission pressures in Birmingham and Warwickshire will be 33,000 and 11,000 volts. The pressure of the main underground transmission lines from Stourport to Halesowen will be 33,000 volts, and that of the main overhead transmission lines will be 66,000 volts. The supply will be stepped down to 5,500 volts for local secondary transmission.

The arrangements as regards existing generating stations are as follows: There shall be utilised in conjunction with the new capital stations, an existing temporary generating station situated at Nechells, and the most economical portion of the plant in the Summer Lane generating station, both of which belong to the Birmingham Corporation, also the most economical portion of the plant in the Smethwick station belonging to the Shropshire, &c. Co. As considered economically advisable, the existing stations at Water Street and Chester Street, belonging to the Birmingham Corporation, will be closed down, also the generating station belonging to the Sutton Coldfield Corporation, and the uneconomical portion of the generating plant at the Summer Lane station of the Birmingham Corporation; the generating stations at Kidderminster and Dudley, belonging to the Shropshire, &c., Co., as well as those of the Redditch and Malvern Urban District Councils, and the Ludlow Electric Light Co. will also be closed down. All these stations will, however, continue to be used as sub-stations or distributing centres for the districts which they now serve. The existing generating stations belonging to the Worcester Corporation will continue to run, but the supply from these stations will be augmented by means of a bulk supply from the new capital station at Stourport when the load on the Worcester Corporation undertaking is greater than the present plant is capable of supplying.

The generating and other plant belonging to the Birmingham Corporation and the Shropshire, &c., Co. that will not be required will be disposed of, and the amount so realised applied to extinguish the loans outstanding against these assets, or credited to capital account, as the case may be. The balance, if any, will be made good from the reserve fund account of the undertaking concerned. The auxiliary supply, which is now being purchased from the private generating station of the Dunlop Rubber Co. by the Birmingham Corporation, will be discontinued.

The following capital power stations are in course of construction or are to be constructed in successive stages as required:—

	Plant being installed, kW.	Ultimate capacity, kW.
Birmingham Corporation—		
Nechells	35,000	110,000
Hams Hall	—	300,000
Shropshire, &c., Co.—		
Stourport	—	105,000

No works under Section 18 of the Electricity (Supply) Act, 1919, will be constructed, and there are no existing generating stations in the district used solely for (*a*) railways, (*b*) tramways. Negotiations have been opened with the Midland Railway Co., in connection with a supply of power for railway purposes.

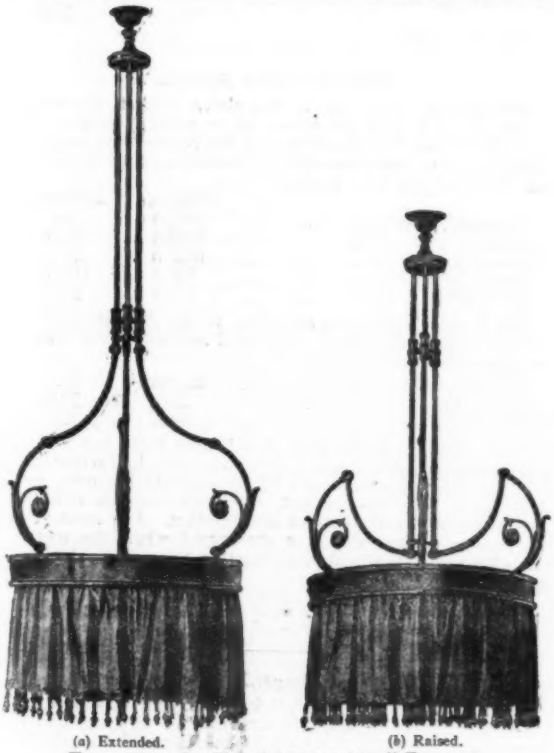
The Hams Hall site is an ideal one for the supply of railways over a large area, and a supply of 25-period a.c. is peculiarly suitable for railway working. The district at present contains approximately 390 route miles of railways, and there are about 2,000 route miles of railways within a 50-miles radius of Birmingham.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Adjustalite" Pendant.

An adjustable lighting pendant without visible cords and the usual counterpoise is made by The Rhodes Fittings Co., Ltd., 224, Upper Thames Street, E.C.4. This device, known as the "Adjustalite" pendant, is illustrated in figs. 1 and 2. It will be seen that when the fitting is raised from the fully extended position (*a*), by sliding the pendant holders over the tubular guides, the upper arms of the fitting are raised, drawing up the lamp and shade (*b*). In this particular example the range of adjustment is 18 in.



(*a*) Extended. (*b*) Raised.

Figs. 1 and 2.—The "Adjustalite" Pendant.

The "Priory" Distribution Board.

We have received from the Priory Electrical Engineering Co., Bath Street, Birmingham, a new distribution board (fig. 3) which has just been placed upon the market. As will be seen from the illustration (fig. 4) this board is made to facilitate the work of wiring up. Two pieces of angle iron are fixed to the wall and the frame supporting the fuse units is hinged to one of them. The service cables and distributors are then connected and the frame is swung back and held in place by means of screws which fit into two pillars cast on the other piece of angle iron. The sheet steel case is then slipped over and fastened by screws into the sides of the angle iron supports. The board is arranged for six ways with two fuses per way. The cables are led into the box through an insulating separator and an asbestos fillet is fitted between the upper and lower rows of fuses. The service cables are connected to a small busbar to which one terminal of each fuse is clamped by a screw. The construction of the board is very substantial, and all parts are easily connected up and assembled.

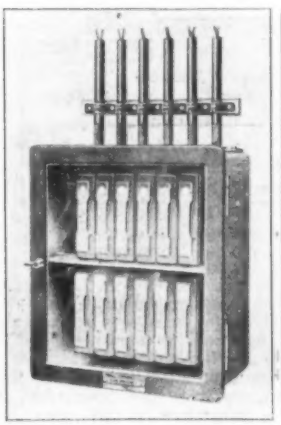


Fig. 3.—The "Priory" Distribution Board.

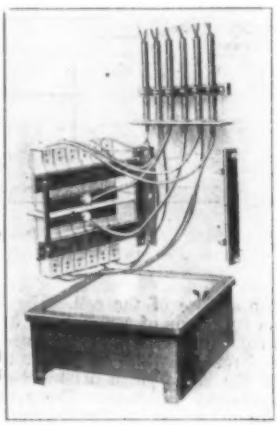


Fig. 4.—Method of Wiring.

The "Baby Paragon" Switch and Fuse.

In our issue of February 25th last (page 258) we described the "Baby Paragon" switch designed by The Midland Electric Manufacturing Co., Ltd., Barford Street, Birming-

ham. We have now been made acquainted with a further development of this line, the "Baby Paragon" combined switch and fuse gear. As will be seen from the illustration (fig. 5), the fuses are arranged above the switch, which is of the type previously described. The fuses have a looped break of 2½ in.,

Fig. 5.—The "Baby Paragon" Switch and Fuse.

and are designed in compliance with the Home Office regulations. This gear is made in either two or three-pole types for 250 or 500-V circuits.

A Selenium Current Regulator.

In connection with the 5,000-amp., 6-volt motor generator which was installed at the National Physical Laboratory for the purpose of assisting in the buried cables research and general work,* a current regulator has been constructed which employs selenium cells as a means of operating the first relays. It will be seen from the diagram, fig. 6, that leads from the standard resistance used for current measurement are brought to an ordinary potentiometer circuit; the two selenium cells are mounted one on each side in front of the ground-glass galvanometer scale and are arranged so that when the galvanometer is out of balance, due to the current varying from the normal, the light spot completely illuminates

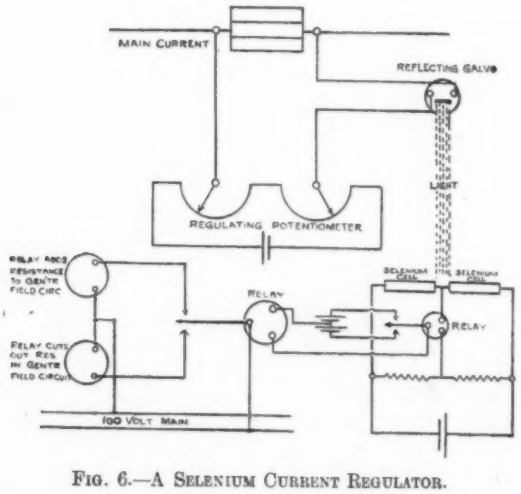


Fig. 6.—A Selenium Current Regulator.

the surface of the cell. The two selenium cells are arranged as two arms of a resistance bridge, the other two arms being made up by a plug-resistance box, and a sensitive moving-coil relay is connected across the usual galvanometer terminals of the bridge with a 30-volt accumulator battery to give the necessary pressure. The arrangement of the remainder of the relays which finally vary a resistance in the excitation circuit of the current generator is shown in the diagram. The selenium cells respond very quickly, and the arrangement will maintain a current of, say, 1,000 amp. constant to within 0.2 per cent. for a whole day. A far higher degree of sensitiveness can be obtained, since in the case under review, owing to the current normally varying in rapid fluctuations of as much as 3 per cent., the galvanometer was stiffened so that the movement from the centre of the scale to one or other of the selenium cells corresponded to a change of current of 0.1 per cent. Unfortunately the resistance of the selenium cells was not sufficiently constant from day to day, and they could not always be relied upon to remain sufficiently uniform for regulation to be effected without adjustment of the bridge arms for a longer period than 10 hours, but the method has such great advantages for the regulation of large currents that further work is being done both by way of endeavouring to make selenium cells which will remain more constant and also of using a thermopile to be operated by the heat transmitted from the galvanometer mirror. The main advantages of regulation of this type are that the operating forces are extremely small; the drop over the shunt being only 0.1 volt, a high degree of sensitiveness can be obtained; and the regulator will deal, with the aid of suitable shunts, with currents up to several thousand amperes.

* Elec. Rev., Aug. 20th, 1920, p. 232.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Self-synchronising Rotary Converters.

Would you, or some of your readers, please supply a good theoretical explanation of how a self-synchronising rotary-converter brings itself into synchronism? A recent book on rotary-converters seems to fail badly by skimming over this question very lightly.

1,500 kW.

July 25th, 1921.

Battery Explosions.

Could you through the medium of your excellent paper explain the following phenomenon:—

The power-house attendant at my place of employment was placing a fourth cell on charge (the three previously charging were connected to the +ve side of the board and had received practically a full normal charge); when he connected the fourth cell to the −ve and then to the three cells previously charging there was a report like a pistol shot, and quite as loud, and the electrolyte in the fourth cell assumed a milky-white appearance, and seemed to be greatly disturbed. There was also a disturbance in the third cell, but not to such a large extent as in the fourth. He attempted to reproduce the effect but could not, but a few weeks later the same thing occurred under exactly similar conditions.

Denze.

July 29th, 1921.

Abnormal Meter Records.

With further reference to the above subject, the solution of Mr. Kernick does not appear to be entirely correct.

If we assume the coincidence of the readings at the end of February to be zero, the following would appear in the reading book for the first meter:—

	Reading.	Difference.
December, 1920	9947.0	—
January, 1921	9982.0	35.0
February, 1921	0000.0	18.0
March, 1921	123.0	123.0
April, 1921	144.0	21.0

This should have been, according to Mr. Kernick's solution (assuming that the March and April readings were taken by the same man):—

February, 1921	0000.0	18.0
March, 1921	12.3	12.3
April, 1921	14.4	2.1

If the readings at the end of February were not zero, the case becomes more confusing, as will be seen by further study.

If the April readings were taken correctly the error would easily have been seen; if not, the April readings would not be normal or give the correct consumption. Any error of this description is neutralised or discovered when the meter is correctly read. It would be interesting to see the actual readings.

Thomas Southgate.

Ipswich.
August 1st, 1921.

Testing and Repairing Magnetos.

With reference to "Mag's" letter in your last issue, as a practical magneto repairer, it surprises me to learn that any firm adopts the method which he mentions of removing slip rings and ball races.

The armature tests mentioned, from my point of view, are absolutely useless; however, to go into a technical discussion of these would take up much valuable space, so I will as simply as possible give an outline of methods practised in most repair shops.

With regard to armature testing, this is usually done on a specially constructed test board; current is supplied to the board from a battery of 4 to 8 volts, depending on the size

of the armature. This current flows through the primary winding of the armature under test and through a hammer make and break, actuated by the magnetism from the armature core; in some cases a motor-driven rotary make and break is used. The current in the primary circuit is interrupted in this manner on the test board, whereas, in the machine, it is interrupted by the contact-breaker, with this difference: In the machine the current in the armature is self-induced through the magnets, but on the test board the current is supplied from a battery. It naturally follows from this that a high voltage is induced in the secondary winding while under test.

The high voltage is collected from the slip ring, and taken to an adjustable spark-gap.

A standard capacity condenser and switch are included in the test board connected across the make and break. With this test board it is possible to test the condenser, primary and secondary circuits, and slip ring without disconnecting the armature windings.

To operate the test board, current is switched on the core, or armature; if the make and break fails to act through lack of magnetism in the core, it shows either an open or short circuit in the primary winding, though these faults are rare. With a dead short the safety fuse in the primary circuit will blow; it is usual in a case like this, that the fault will be found in the condenser. Taking the primary winding as O.K., the make and break should be vibrating steadily but fast, without sparking at the points. If sparking is taking place badly, at the points, it shows a faulty condenser, such as low capacity or punctured. In this event the test board condenser is switched into circuit, which will give sparkless make and break.

With primary winding and condenser O.K. there should, if the h.p. winding and slip ring are O.K., be a continuous line of sparking taking place between the points of the adjustable spark-gap, the distance between the points varying with different sizes and makes of armatures.

Should it be found that no sparking takes place, if the adjustable gap is opened beyond a certain point which practice tells it should spark at, it naturally points to a broken-down slip ring or h.p. winding. For example, supposing an armature should be capable of sparking across a 12-millimetre gap at 6 volts, and that no sparking occurs at a 5-millimetre gap, it clearly shows here that the sparking is taking place either in the high-pressure winding, or in the slip ring; if the fault is in the slip ring, it will betray itself by the smell of burning ebonite, otherwise the h.p. winding has broken down.

With regard to the removal of ball races and slip rings, a ball race is drawn off the spindle by a special tool, of which there are several kinds. The tool I am writing of has a lip grip, which grips down and all round the ball track of the race, a screwed bolt through the centre of the tool is screwed down on the end of the spindle, drawing the race off easily and quite undamaged; it is then, of course, an easy matter to remove the slip ring.

I quite agree with "Mag" that the majority of magneto repair shops have no system, and I might add, no knowledge, if they employ the methods "Mag" writes of.

Repairer.

August 1st, 1921.

The E.P.E.A. and Dover, &c.

With reference to the letter in this week's issue from "Wake Up," who seems easily amused, I think all public supply engineers will be equally amused at the latter part of his letter.

His statement: "Station operation is only routine work—there is nothing in it," reminds me of a little episode in my experience of seven or eight years ago.

The station, a small one, had three a.c., three-phase generators, each of 200 kW capacity, and the machine panels on the switchboard were fitted with an ammeter on each phase, but without a wattmeter or power-factor indicator.

The manufacturers were asked to send someone to test these ammeters, so they sent the engineer who had originally erected the switchboard and generators to superintend the job. This gentleman, who, like "Wake Up," was bursting with the "nothing in it" knowledge of power station work, of course declined the offer of assistance of the charge engineer in changing the sets over as required, with the remark that he could manage that himself quite easily. Two of the machines were on load and the other one was run up to speed. There would be about 200 amperes on all three ammeters of both machines at the time when the charge engineer left to attend to other duties. It was not very long before the manufacturer's representative sent for the charge engineer, who found him in a bewildered condition; he had paralleled the third machine, and had now about 250 amperes per phase on all three machines, and was wanting to know where the other load had come from. The charge engineer soon put him right, which, of course, any switchboard attendant could have done.

"Wake Up" should not underrate work which he has apparently never undertaken.

Nothinlnit.

Coventry.
July 30th, 1921.

RESTRICTIVE COVENANTS.

By a Legal Contributor.

All men of business who have occasion to employ clerks or assistants, are well aware of the necessity of inserting a restrictive clause in the agreement of service. Keen competition makes it difficult to make and keep a connection; and the employer is often anxious to prevent a discharged clerk or assistant drawing off the custom of his late master, or entering into direct competition with him.

Again, when a business is sold, the purchaser will naturally want to prevent the vendor competing with him. In either case, a restrictive covenant of some kind becomes necessary. The case of Bowler *v.* Lovegrove, which was reported in *The Times* a few months ago, renders it desirable to refer to the matter once more. It is necessary to point out that, as a general rule, a covenant which binds a man not to practise his calling is looked upon with suspicion. The reason is that if a man deliberately sells the right which all men have in a free country to the exercise of their calling, he deprives the public of the benefit of his skill and experience, while he abandons what may be his means of livelihood. A principle of law has, therefore, been evolved, having its origin in the famous case of Mitchell *v.* Reynolds, which was decided in 1712, that contracts in restraint of trade are void, and must not be enforced by the Courts. If an electrical engineer at the present day were to enter into a bond which prevented him from carrying on his business anywhere for the rest of his natural life, no court of justice would enforce its due performance.

But while contracts in total restraint of trade are void, it has become a well settled rule that if restriction is limited as to area, and there is "consideration" for the bargain, the goodwill of a business may be made the proper subject matter of a contract. And so the well-known "bond" into which the vendor of a business enters is recognised in, and will always be enforced and respected by a court of justice. Were it otherwise, the sale of a connection would be rendered impossible, as nothing could operate to prevent the vendor from interfering with the practice which he himself had disposed of for a substantial sum of money. Similarly, unless an assistant or servant could be put under restriction, employment anywhere would be dangerous on any terms.

Such is the bare outline of a branch of law which is surrounded with many technicalities. Into these it is not our purpose to inquire at any length, but there are a few points which demand further elucidation. It has been pointed out that the restriction must be limited as to area. It would be wholly unreasonable, for instance, to prevent an assistant from exercising his calling anywhere in the British Isles. Many cases have arisen in the Courts as to what is a reasonable limit. In Horner *v.* Graves (7 Bing. 735) it was held to be unreasonable to restrict a dentist from practising anywhere within 200 miles from York. On the other hand, to borrow an instance from the legal profession, a covenant preventing a solicitor from practising as such anywhere in England for 20 years has been held to be reasonable and capable of enforcement (Whittaker *v.* Howe, 3 Bras. 383). It follows, therefore, that in marking the border line, the Court will be influenced in a large measure by the nature of the business. The available means of communication are also important. By means of railways, telephones, &c., a practice can be extended over a much wider area at the present day than would have been possible at the close of the last century. That the Court is willing to enlarge the boundary in certain cases, even to the confines of the habitable globe,

was clearly demonstrated in 1896, when world-wide restriction was placed upon the manufacture of a particular class of guns and armament. Although this case could never have any direct application to the electrical profession, yet it serves to show the elastic nature of rules by which the Court is governed in these matters.

With regard to time, there does not appear to be any restriction. Nevertheless, if a man binds himself not to practise for a limited period, the area of restriction may receive a slight extension. The rule by which the boundary should be determined was thus expressed in the case of Horner *v.* Graves, to which allusion has already been made:—

"The restraint must be only such as to afford a fair protection to the interests of the party in favour of whom it is given, and not so large as to interfere with the interests of the public."

The consideration—another essential feature of these contracts—is the next matter which deserves attention. And upon this point, so long as the Court is satisfied that there is a consideration which is not merely colourable, the contract will be enforced. The adequacy of the consideration is left entirely to the parties themselves. Instances could be cited without number to show what has been held as a reasonable consideration. In the case of Sainter *v.* Fergusson (7 C.B. 716) the engagement of the defendant as assistant was held to be sufficient consideration for an undertaking on his part not to practise within a radius of seven miles after the termination of his employment.

Having made an attempt to indicate the features which are essential to contracts in restraint of trade, we now propose to consider what constitutes a breach of such contract. In most contracts the covenant is in the following form: The vendor undertakes that he "will not at any time hereafter, directly or indirectly, and either alone or in partnership with or as assistant to any other person or persons, carry on the profession or business of, &c., within a certain area." A further clause prohibiting practice "in open competition" sometimes finds its way into the deed.

The question naturally arises, What constitutes practising? Most men—or their consciences—will be able to answer this question without difficulty, but doubtful points arise from time to time. In the case of Palmer *v.* Mallett (36 Ch. D.411) it was decided that a person acting only as a salaried assistant was carrying on the profession of a surgeon, and that to do so was a breach of the covenant. In that case Lord Justice Cotton said: "Carrying on a trade implies, to my mind, that the person engaged in it is engaged in it *qua* trade—that is to say, as a trade producing profit or loss which is to be shared by him; and that is not the case if he is merely a salaried assistant. . . . I cannot come to the conclusion that a man is less carrying on the profession of a surgeon because he is doing so as assistant to someone else. 'Profession' is different from trade, and it is much more emphatic, to my mind, than if 'business' alone were here. When, as here, the words 'carrying on the business or profession of a surgeon' are merely used to denote what is done by a man acting as a surgeon, a man, in my opinion, acts as surgeon none the less because he is not the principal or engaged in the business as a partner, but is merely carrying it on as an assistant."

It will be observed that the case just referred to involved the discussion of a covenant in force between the vendor and purchaser of a business. The Courts will construe such a covenant less favourably to the person bound than a covenant which prevents a servant from competing with his former master. At the same time, even in the case of a servant a covenant will be enforced if not unduly harsh.

An example of the class of case which often comes before the Courts is to be found in Herbert Morris *v.* Saxelby (1916), (1 A.C. 688). In that case the plaintiffs were engaged in the manufacture of very special forms of machinery, including pulley-blocks, runways, and travelling cranes. Their business was a leading one in the United Kingdom in this class of machinery, and extended over a large part of the United Kingdom. In March, 1911, the defendant entered into an agreement under which his salary was £3 17s. 6d. a week, and his engagement for two years certain. By Clause 7 of the agreement he covenanted with the plaintiffs that he would not:—

At any time during a period of seven years from the date of his ceasing to be employed by the company, whether under this agreement or otherwise howsoever, either in the United Kingdom of Great Britain or (*sic*) Ireland, carry on, either as principal, agent, servant, or otherwise, alone or jointly, or in connection with any other person, firm or company, or be concerned or assist, directly or indirectly, whether for reward or otherwise, in the sale or manufacture of pulley-blocks, hand overhead runways, electric overhead runways, hand overhead travelling cranes, or any part thereof, or be concerned or assist as aforesaid in any business connected with such sale or manufacture.

On leaving the plaintiffs' employment, the defendant at once went into the employment of the French agents of the plaintiffs, but in March, 1914, he entered the service of Vaughan & Son, Ltd., Manchester, who were the principal competitors of the plaintiffs in the manufacture of some of the articles mentioned in the above Clause 7. Thereupon the plaintiffs brought these proceedings, claiming an injunction against the defendant substantially in the terms of this clause.

In these circumstances, Mr. Justice Sargant held that while the covenant was not unreasonable from the plaintiffs' point of view inasmuch as it was necessary for the purposes of their business, it would be wrong to enforce it against the defendant, as it would deprive him and the public of the benefit of the skill and experience which he had acquired while in the plaintiffs' employment, and prevent him using his knowledge. By a majority the Court of Appeal upheld this decision. The Master of the Rolls pointed out that restrictive covenants are usual in three cases: (i) Where a trade secret requires protection; (ii) where the goodwill of a business is sold; (iii) where the liberty of a former employé is to be restricted. While they must be construed very strictly in (i) and possibly also in (ii), a greater freedom is to be exercised in (iii). In applying the older decisions to the facts of the case, the Court was animated by the desire to prevent the defendant being deprived of the advantage of all his previously-acquired knowledge, and to relieve him from having to start the world afresh. The case emphasises the importance of consulting a lawyer before any document containing a restrictive covenant is signed.

A recent case on the subject (Attwood *v.* Lamont, 1920, 3 K.B. 571) which was reported in the December number of the *Law Reports*, is interesting as showing that the Court may declare a covenant void because it will prevent competition. In that case the plaintiff carried on business at Kidderminster as a draper, tailor, and general outfitter. By a contract of employment of the defendant by the plaintiff, as an assistant in his business at an annual salary and commission in the tailoring department, the plaintiff declared that he was willing to employ the defendant upon his entering into the agreement not to trade in opposition to him. The defendant agreed that he would not at any time thereafter "either on his own account or on that of any wife of his or in partnership with or as assistant, servant, or agent to any other person, persons, or company carry on or be in any way directly or indirectly concerned in any of the following trades or businesses; that is to say, the trade or business of a tailor, dressmaker, general draper, milliner, hatter, haberdasher, gentlemen's, ladies', or children's outfitter, at any place within a radius of ten miles of Kidderminster." The defendant subsequently set up business as a tailor at Worcester, outside the ten miles' limit, but obtained and executed tailoring orders in Kidderminster. The Divisional Court held that the covenant was wider than was reasonably necessary for the protection of the

plaintiff's business, but that it was severable by striking out the enumerated trades except that of a tailor and limiting its operation to the trade or business of a tailor, and granted an injunction restricted to the tailoring trade. The Court of Appeal, however, held that the covenant being a single covenant for the protection of the plaintiff's entire business and not several covenants for the protection of his several businesses could not be severed, and that even if the covenant could be severed by confining it to the tailoring business, it would still be void as being in restraint of competition.

The following points may now be taken to be established:—

1. It is the covenantee who has to show that the restraint sought to be imposed upon the covenantor goes no further than is reasonable for the protection of his business.

2. The restraint must be not only in the interests of the covenantee but in the interests of both the contracting parties.

3. An employer is not entitled by a covenant taken from his employé to protect himself after the employment has ceased against his former servant's competition, although a purchaser of goodwill is entitled to protect himself against such competition on the part of his vendor.

4. Previously accepted rules as to the doctrine of severance require careful application if not entire reconsideration.

In Bowler *v.* Lovegrove, the case referred to at the beginning of this article, we see a remarkable application of this principle. There a young man agreed to act as clerk at a salary of £3 a week to auctioneers and estate agents. He bound himself for the term of one year after his employment ceased not to enter into or carry on the business of auctioneer or estate agent, or to act as clerk, &c., in Portsmouth and Gosport. Having left the employment he set up on his own account. The judge having found as a fact that the clause was put in solely for the purpose of preventing competition, he came to the conclusion that it could not be enforced.

REVIEWS.

The Engineer's Year-Book, 1921. Compiled and edited by H.R. Kempe, M.Inst.C.E., M.I.Mech.E., M.I.E.E., and W. Hanneford Smith. Pp. 2,642; figs. 2,250. London: Crosby Lockwood & Son. Price 30s. net.

First published in 1894, Kempe's Year-Book at once took the lead as the most complete and comprehensive work of its kind then obtainable by engineers, an enviable position which it has ever since maintained. Now in its twenty-eighth edition and extending to some 2,600 pages, this compendium of all that is most modern in civil, mechanical, electrical, gas, marine, mining, and metallurgical engineering places before the reader a veritable encyclopædia of up-to-date engineering practice. But unlike other encyclopædias, Kempe's is revised annually, all obsolete matter undergoing a drastic process of excision, and though many of the startling engineering novelties of the war period were not too well "boomed," few of them appear to have escaped inclusion in its pages. And thus we find in this single volume probably more recent information appertaining to well-nigh every phase of engineering than is to be found in any other book in the English language.

Following a succinct "Summary of Engineering Progress during 1920," the main part of the work is divided into 43 sections, each section forming a practically complete treatise, contributed by one or more experts on its particular subject. In these sections are interspersed miscellaneous data and numerous descriptions of typical mechanisms and appliances, a notable feature being the advantage which has been taken of the permission given by the leading engineering Institutions to reproduce data and information from papers included in their recent *Transactions*. Section XIII, which treats of "Electric Traction," and that part of Section XXXVII which deals with "Electric Welding," have been thoroughly revised by Mr. A. H. Allen and Mr. T. T. Heaton, and will probably prove most serviceable for consultation purposes to our readers. Internal-combustion engines have received careful consideration at the hands of Mr. G. A. Burls and Mr. A. Vincent Clarke, while the present position regarding "Steam Engines and Boilers" and "Boiler Plants" has been dealt with at length by Messrs. Wm. H. Booth and D. Brownlie respectively. The ever-growing part taken by electricity in mining operations is touched upon by Prof. Henry Louis in his absorbing exposition of "Mining" in Section XXXVI. Other informative sections coming within the scope of our readers' possible requirements are those on "Steam Engineering," by Mr. Frank Foster; "Steam Turbines," by Mr. H. L. Guy; and "The Development of Water Power," by Mr. A. Surveyer.

As regards binding, paper, printing, and illustrations, the book leaves nothing to be desired, but the index to contents is inadequate for present-day high-speed requirements. It is not sufficient to say that Section XXIX commences on page 1339. The section extends to 244 pages, and is divided into six parts, each one of which calls for separate pagination. Nor can we find in the index, in which much cross-referencing still remains to be done, any mention of the names of many of the authors whose contributions appear in the book. For instance, in the "List of Associate-Editors and Contributors" we see that Mr. J. H. Horobin has dealt with "Steam and Power Plants," but the author's name is not indexed. We would also suggest that having now reached nearly five times its original size, the volume has become too "podgy" to handle conveniently, and in future editions an increase in the size rather than in the number of pages should be aimed at.

Domestic Fuel Consumption. By Prof. A. H. Barker, B.A., B.Sc. Pp. x+159; figs. 26. London: Constable & Co., Ltd. Price 14s. net.

The work of Prof. Barker on heating and ventilation is well known; his independent attitude as a scientific investigator renders this latest contribution most welcome and valuable, particularly at a time when engineers are awakening to the possibilities of the domestic field and the promise of work valuable to themselves, their clients, and the State, so soon as the householder can be made to realise the place of science in the organisation of the home.

Prof. Barker's book should be read and kept for handy reference by all interested in the electrical industry; to the consumer's engineer and the contractor it will prove most useful, not the less so because the arguments are expressed in language and in similes suitable for passing on to the layman.

The early part of the work is devoted to a general study of the laws of heat, and an attempt is made to enable the reader to visualise its behaviour, and particularly the idea of heat quantity as apart from temperature; in later chapters, when discussing the design of cookery appliances, the writer also shows very clearly the importance of conditions which affect the rate of heat transmission as between the source, the utensil, and the food being cooked—exhibiting the quite subsidiary importance of mere temperature measurements in this connection, and so revealing important considerations in the design of ovens, &c.

The possession on the part of the householder of any clear ideas on the heat content of familiar quantities of fuel, heated water, food, &c., is rare, whilst the notions associated with waste of calorific value in using fire and gas are generally most vague, and may be stimulated considerably by the professor's references to the B.th.u.'s contained in a cup of hot tea, and his explanations of the manner in which the heat is continually "soaking" out of hot bodies and into their colder surroundings.

The reviewer has found by experience the value of these simple expedients for popularising theory, and avoiding the sort of mental paralysis which seems to trouble even educated people when presented with the simplest engineering statements in scientific form; for example, the exhibition of weighed heaps of coal equivalent to the energy production required for keeping an electric lamp alight for an hour is quite an excellent way of countering the questioner who wants to know why electricity should be so dear as "it all goes back to the works again."

However, the author's attempt to write in a popular vein sometimes leads him to slip below the proper minimum of scientific statement, as when he ends his frequent praises of electricity by deploring its costliness, declaring, for example, that it should never be used for heating at rates higher than 1d. per unit, and making similar statements which, although perhaps revealing his meaning to engineering readers, have no intrinsic value unaccompanied by the comparative rates for gas and other fuels. Such generalisations are apt to confuse a reading public which may be paying to-day anything from seven-eighths of a penny to 4d. per unit for electricity against 2s. 6d. to 10s. 6d. per 1,000 cubic feet for gas; the dear gas sometimes being associated with the cheap electricity and *vice versa*.

Rather pessimistic references are made to the prospect of educating owners and servants in the proper use of well-designed and economical apparatus, as also to the apathy of property owners in relation to house equipment, and the possibility of getting higher rent for outfits which offer the tenant a tangible economy in daily use. The increasing number of owner occupiers, and the need for reducing expenditure will certainly lead to a much higher standard of skill and care in home work in the next few years; the passing of cheap coal and cheap domestic help is not entirely a disadvantage.

The author appears to think that hire of heating and cooking apparatus, whilst good at first, may prove a disadvantage later, as more efficient forms are produced, and hiring under-

takers may not be tempted to change the older types for fear of losing revenue.

Both gas and electricity suppliers have got beyond that crude stage of development, and realise that their users must have the best if the business is to continue extending, moreover the keen competition for the supply of heat which will be a feature of the future, will keep both industries keyed up to providing the latest means for using the energy which they desire to sell.

It would appear from internal evidence as if much of this work had been prepared during the war, not, however, a disadvantage so long as the miners elect to give us a reminder of those evil days at frequent intervals. The figures on page 18 concerning the values of gas rather remind us of the classification of eggs into new-laid, fresh, and mere eggs; the writer is perhaps unduly hard on the gas people, as he does not fully explain that in lowering calorific value and selling on a heat basis, they hope to get a higher percentage return from the coal, in which advantage presumably the user would share sooner or later.

Writers of books of this class on gas and electricity can seldom resist the temptation to show how meters should be read, and how they can be used to check the consumption in appliances, or even how appliances can be made to check the accuracy of the meters; this is always a dangerous sort of instruction to give owing to the variations in pressure and quality and the inaccuracies in the making or adjustment of consuming devices; however, the average householder is more interested in the amount of his quarterly bill, and generally satisfied that meters are about as reliable as the clocks, scales, and pint pots by which most of his many transactions are regulated.

Some figures are given to enable the cost of using electrical apparatus to be computed, and the rather happy expression "little unit" is employed to denote the watt-hour, but a little sum on page 33, in which a weekly bill is made up of two-thirds lighting and one-third kettle consumption, all at 8d. a unit, hardly represents average practice; whilst the writer's recommendation for obtaining a dim light by underrunning lamps, and his comparisons of the cost of gas and electric lighting, show some neglect of the light/energy characteristics of the incandescent filament and of the results achieved with, and at their best only possible to, the combinations of reflector and light source which the electric lighting expert now gives us.

However, the author has nothing but praise for electric lighting, although he thinks most people take whatever they find installed; that is not so, they make considerable efforts to get the more modern light, even paying heavy prices for fitting it into houses which do not belong to them, and find in the end that their money has been well invested on account of the incidental savings and conveniences.

The chapters devoted to cooking and room heating are of great interest and value, and should be read with care by all electrical engineers; they put the problems in a clear light, and show how carefully statements on appliance efficiency should be received.

The author thinks it difficult to get the best results with modern appliances, because the owners or their servants do not know enough; the real trouble is that they know too much, and unlearn with difficulty—for generations it has been customary to regard the heat of a fire as one does the heat of the sun or the flow of a stream, something from which to snatch a certain value, but to regulate hardly at all. Even the household fuel bill is looked upon rather as a form of rent, wealth permitting the luxury of waste and poverty meaning deprivation; but the last idea of all has been to get better value out of the expenditure or to spend more on permanent equipment in order to reduce the running cost of fuel.

If this interesting work leads to a closer study of heat energy and its detailed use, and helps the layman to a clearer understanding of the value of fuels, whether crude or in the progressively higher forms of gas and electricity, it will have served a most useful purpose. J. W. B.

Electrification of Railways. By H. F. Trewman, M.A. Pp. vi+78; 13 illustrations. London: Sir I. Pitman & Sons. Price 2s. 6d. net.

In the space at his disposal the author has only been able to sketch in the groundwork of his subject with a wide brush, detailed consideration being left to the more pretentious text-books. Stress has been laid on the commercial rather than the technical aspects of the question, since the former constitute the true test of all engineering propositions.

This little book should be of service, owing to the fact that it deals with those basic principles which are apt to be obscured by masses of technical detail.

Some of the questions discussed are of a highly controversial nature, as, for example, the relative merits of alternating and direct current for traction purposes, but the author has evidently striven to be quite impartial in his statement of advantages and disadvantages.

To illustrate the remarks on the importance of the load-factor, a typical load-curve for a tramway station, with its heavy morning and evening peaks, is given. It would have been interesting to compare this curve with that for a power station of a main-line railway. It would appear that the latter should have a much more uniform load, especially if goods traffic is handled electrically, since this would be dealt with as far as possible during the slack hours for passenger traffic.

A comparison is made between the costs of operation of steam and electric traction, from which it is deduced that with electric working, goods traffic is likely to be more profitable than passenger traffic. The results arrived at would be more valuable if fuller information were given as to the components of the costs on which they were based.

The book is simply and clearly written, and very little technical knowledge is required to understand the text, so that it should prove valuable to all who wish to gain an insight into the nature of the problems to be considered in connection with the electrification of railways.

BUSINESS NOTES.

Bankruptcy Proceedings.—R. P. Baker and F. C. Stubbs, electrical engineers (trading as The Sheffield Electric Construction Co.), 124, Pond Street, Sheffield. The following are creditors:—

	£		£
Edison & Swan Electric Co. ...	133	Morton, Wm. A.	21
British Thomson-Houston Co. ...	56	Bairds, Ltd.	14
Hallamshire Electric Co. ...	50	Parnall	13
Dunford & Elliott, Ltd. ...	35	Griffin, Ernest, & Co.	13
Siemens Bros.	50	Metropolitan-Vickers Co.	11
Smith, H. W., & Co., Ltd. ...	30	Oliver Typewriter Co.	10
General Electric Co.	20		

Joseph Francis Lyons, electrical engineer, 27, Palmerston Street, Front Street, Consett, Durham. The following are creditors:—

	£		£
Anderson	15	Express Electrical Co.	10
Bridgewater	200	Electric Lamp Mfg. & Supplies Co.	28
British Electrical Mfg. Co. ...	18	Dum Brill Plant Co.	130
British Thomson-Houston Co. ...	27	Davidson, J. W., & Sons	45
Callender's Cable & Construction Co., Ltd.	23	Crabtree, J. R., & Co.	33
Cleveland and Durham Electric Co.	10	Foster, R. C., & Co.	20
Consett Guardian	23	Foxall	70
Fletcher Bros.	14	General Electric Co.	108
Gibson, W. R. & R.	17	Gladson & Co.	27
Hudson's Electrical Eng. Co. ...	37	Metallic Electric Engineering Co.	128
Jackson Electric Stove Co. ...	16	Railway Passengers' Assurance Co.	38
Siemens Bros.	37	Tyne Printing Works, Ltd. ...	13
Wardle Engineering Co., Ltd. ...	15	Z Electric Lamp & Supplies Co.	21
Falk, Stadelmann & Co.	28		

I. J. Hodson and B. H. Newman, electrical engineers, Exeter.—Trustee, Mr. A. H. Ward, O.R., 9, Bedford Circus, Exeter; released, May 25th.

Re Robert Charles Jones, lately carrying on business as Elect.-Ma. Engineering Co., 10, Caledonia Street, King's Cross, N. A sitting of the London Bankruptcy Court was held on July 29th before Mr. Registrar Francke for the public examination of this debtor, who failed last March with liabilities £933 (unsecured £838), and assets, "cash at bankers, £6 18s. 8d." Questioned by Mr. F. T. Garton, official receiver, the debtor stated that having acted as a canvasser for the electrical trade till 1908, he commenced business on his own account as an electrical contractor at 27, Cursitor Street, Chancery Lane, W.C., under the style of "The Globe Electrical Co.," which he carried on till 1910, when he closed it and obtained employment in the same trade. In September, 1917, he again commenced business on his own account as an electrical engineer and power expert, under the style of "Elect-Ma," and later under the style of "Charles R. Jones," working principally from his private address. In October, 1919, he was joined by a Mr. Tanner, who agreed to find £200 on consideration of an equal share of the profits; they took premises at 10, Caledonia Street, and in June, 1920, in order to commence business as wholesale dealers in electrical accessories, witness advertised for a partner, with the result that a Mr. Midgley joined them, on terms that he provided £200 as a premium and a further £200 for a one-sixth share of the net profits, the balance to be divided equally between witness and Mr. Tanner. The business was carried on in that way until last January, when the landlord obtained possession of the premises, and witness then continued it alone from his private address up to the date of the receiving order. He attributed his insolvency to insufficient working capital and heavy expenses of management. The sitting was adjourned till August 9th, further accounts being required by the Official Receiver.

Company Liquidations.—The Stols Electrophone Co. (1914), Ltd., 8, St. Martin's Place, Trafalgar Square, W.C.—At the offices of the Board of Trade, Carey Street, W.C., on July 26th, the statutory meetings of creditors and contributories were held. The statement of affairs showed, as regards creditors, ranking liabilities of £3,971 and net assets £3,786.

thus showing a deficiency of £185. As regards contributories, the paid up capital of the company was £5,000, to which has to be added the above deficiency of £185, making the total deficiency £5,185. Mr. Geo. Digby Pepys, Official Receiver, presided, and reported that the winding-up order was made on March 12th upon the petition of a creditor. The company was incorporated on June 6th, 1914, as the Stols Electrophone Co. (1914), Ltd., with a nominal capital of £5,000, to adopt an agreement dated May, 1914, made between the Stols Electrophone Co. (1913), Ltd., and one Robert A. Buddison on behalf of the 1914 company. The business consisted of the sale of electrophones, devices and instruments to improve the hearing. The instruments were at first purchased from America, and latterly the company manufactured its own instruments. The company's factory was at Shepherd's Bush, and branch businesses had also been carried on at Glasgow, Nottingham, Manchester, Liverpool and Bradford. On March 23rd, 1916, the name of the company was changed to the Stols Electrophone Co. (1914), Ltd. A large amount had been expended on advertising; the total sum from incorporation amounted to £9,000. In February, 1921, a debenture for £5,000 was issued, which would have to be inquired into. A Receiver for the debenture holder was continuing the business, and according to his account, he had made a small profit. The result of the company's trading was as follows:—1915, a net loss of £63; 1916, a net loss of £197; 1917, a net loss of £611; 1918, a net loss of £802; 1919, a net profit of £505; and 1920, a net profit of £550. At the creditors' meeting a resolution was carried that the liquidation should remain in the Official Receiver's hands, and this resolution was endorsed at the shareholders' meeting.

Electrical Maintenance Co. (Liverpool), Ltd., London Road, Liverpool, electrical engineers and factors.—The creditors of the above were called together recently at the offices of Messrs. McAusland, Airey & Page, 8, Victoria Street, Liverpool. Mr. John Airey, the liquidator, submitted a statement of affairs, which showed liabilities of £4,423, of which £4,348 was due to unsecured creditors. There were fully secured creditors for £350, holding securities valued at £424, or an apparent surplus of £74. The assets were estimated to realise £1,740, from which had to be deducted £79 for preferential claims, leaving net assets of £1,661, or a deficiency as regarded the unsecured creditors of £2,761. It was stated that the fully secured creditor was the liquidator, in connection with the money advanced for which he held stock as security. The bank was guaranteed to the extent of £1,400. The partly secured creditors were two of the directors, and their claims arose in respect of cash advanced. The company was registered in December, 1919, with a nominal capital of £2,000, divided into shares of the face value of £1 each. The issued capital amounted to £1,400, of which £700 was issued as fully paid, and the balance for cash. The accounts to April, 1920, showed a small loss. The accounts since that date had not been audited, but it was believed that there had been a loss on the trading of about £1,600 or £1,700. The present position was attributed to heavy buying, and having to sell at a loss. An execution was levied, while at the date of the liquidation two creditors for £300 were in possession and had to be paid out. After discussing the position, the creditors passed a resolution confirming the voluntary liquidation of the company, while an informal committee was also appointed, consisting of the representatives of the Colson Co., Oldham; Oriental and General Trading Co., Ltd., Liverpool; and Mr. Parkin S. Booth. The following are creditors:—

	£		£
Associated Electric Traders ...	23	General Engineering Co.	75
Blundell & Curphy	28	Harnes, W., & Co.	76
Blackwell, R. W., & Co.	125	Metallic Engineering Co.	27
Collier, John, Liverpool, Ltd. ...	18	North Western Motor Co. ...	18
B.T.T. Lamp & Accessories ...	15	Oriental & General Trading Co.	128
Colson Co.	947	Poore, G. & J., Ltd.	16
Concordia Electric Wire Co. ...	18	Oriam Electric Co.	15
Dowsing Radiant Heat Co. ...	42	Sharpe & Killitt	40
Dodd, C. F., & Co., Ltd.	163	Smithwork Lighting Co.	13
Dainty Modern Machine Co. ...	10	Gremens Bros., Ltd.	39
De la Rue, Thomas, Ltd. ...	256	Solar Electric Co.	10
English Electric Co.	11	Siluminite Insulator Co.	50
E.S. Supplies, Ltd.	13	Taylor, F.	94
Electric Heating Co.	81	Hayes & Co.	26
Fuller's United Electric Works ...	109	Hycromet Manufacturing Co. ...	40

Re Bower & Taylor, Ltd., electrical, &c., engineers, 7 and 8, Great Winchester Street, E.C.—Under a compulsory winding-up order made against this company last December upon a creditor's petition, accounts have been lodged showing liabilities £1,899, assets valued at £822, and a deficiency of £1,080, as regards contributories. Mr. H. E. Burgess, Official Receiver and Liquidator, reports that the company was incorporated as a private company in April, 1920, with a nominal capital of £5,000 in £1 shares, and was promoted by Mr. A. Bower for the purpose of acquiring the business of automobile and electrical engineers carried on by him under the style of Motor and Electrical Industries. The only capital issued was £3 to the subscribers to the memorandum of association. Mr. Bower states that Mr. Charles Lawrence Taylor joined him in February, 1920, as manager at a salary of £8 a week and one-third of the profits, and to ensure his interests it was agreed that a company should be formed to acquire the goodwill, plant, machinery, office furniture, and stock-in-trade of the business for £1,000 payable in cash. Mr. Taylor applied for 200 shares in the company, but they were never allotted; no board meetings were held, and differences having arisen between the directors, he withdrew his application, and on December 9th, 1920, obtained judgment against the company for £200. The company has been financed to the extent of about £1,600 by Mr. Bower and various companies in which he is interested. In August, 1920, it was found that the company was being carried on at a loss, and Mr. Bower refused to make further advances. The failure of the company is attributed to depreciation in the value of stock.

Gratze, Ltd.—Winding up voluntarily. Liquidator, Mr. R. B. Gray, 44, Gresham Street, E.C. Meeting of creditors was called for August 4th.

Technical Intelligence Services, Ltd., and The Technical Review, Ltd.—Meetings of creditors were called for August 3rd. Liquidator, Major A. Graham Clark, 53, Victoria Street. Particulars of claims to be sent to the liquidator by September 1st.

Aladdin Renew Electric Lamp Corporation, Ltd. (in voluntary liquidation for the purposes of reconstruction).—Meeting of creditors on August 10th at 82, Victoria Street, London, S.W.1. Liquidator, Sir H. S. Foster, 82, Victoria Street, S.W., who is authorised to consent to the registration of a new company, the Aladdin Renew Electric Lamp Corporation (1921), Ltd., and to enter into an agreement with the same.

Armorduct British Co., Ltd.—Particulars of claims should be sent to the liquidator, Mr. H. A. Pepper, 14, Temple Street, Birmingham, by August 31st.

Trade Announcements.—The Cie. Continentale des Foyers Turbine (Soc. An.), 29, Rue de l'Eveque, Bruxelles, was formed on June 25th, with a capital of one million francs, to exploit the turbine furnaces invented by Mr. V. R. Chadwick, now the technical director of the Turbine Furnace Co., Ltd., of London. Mr. W. H. Badams, the managing director of the English company, has a seat on the board of the Continental company, as representing the English interests. The managing director of the Continental company is Lieut.-Col. B. A. Thornton. The new company has been formed to work the whole of the Continent of Europe and such colonies as belong to the Continental countries.

New show-room premises at 48, Grosvenor Road, Tunbridge Wells, have been opened by The Premier Electrical Co.

Mr. John D. MacKenzie has recently removed from 155a, St. Vincent Street, to 16, Blythswood Square, Glasgow, where he will continue to represent the Scottish interests of the Park Royal Engineering Works, London; the B.E. Co. (of London and Birmingham), Ltd., and Messrs. C. J. Thursfield, Ltd., of Birmingham. He informs us that he is not the Mr. J. D. McKenzie who is starting as an electric light contractor in Edinburgh as noted in this column recently.

Catalogues and Lists.—The Stanton Ironworks Co., Ltd., near Nottingham.—A well-illustrated booklet giving particulars of various types of "Stanton-Hume" reinforced concrete pipes.

City Electrical Co., Ltd., 1, Emerald Street, W.C. 1.—An illustrated and priced list of standard motor starters of several types.

Messrs. Reavell & Co., Ltd., Ranelagh Works, Ipswich.—Pamphlet No. 91, illustrating and describing "Quadruplex" air compressors.

British Insulated & Helsby Cables, Ltd., Prescott, Lancs.—"General Descriptive Catalogue," giving numerous illustrations and descriptions of cables and wires, cable racks, switchgear, joint and terminal boxes, tramway material, meters, Leclanché cells, welding machines, and telegraph material.

The Rhodes Fittings Co., Ltd., 224, Upper Thames Street, E.C. 4.—An illustrated and priced folder dealing with the "Adjustalite" pendant fittings and table standards.

Messrs. J. H. Tucker & Co., Ltd., King's Road, Tyseley, Birmingham.—A folder giving illustrations and prices of quick "make and break" tumbler switches.

The County of London Co.'s Bill.—On July 28th, the Bill being promoted by the County of London Electric Supply Co., Ltd., to enable it to construct a station at Barking, was again considered by a Select Committee of the House of Commons. Sir Harry Renwick gave evidence as to the necessity for the station. He said that there had been seven years' delay in this matter, and the position as regarded supply had become very desperate. The company's City Road and Wandsworth stations were in congested districts and could not be extended. The Barking station would be designed to give an initial supply of 120,000 kW, and would be developed later to give 200,000 kW. The L.C.C. had powers to purchase the company's present system in 1931, but the new station would not be purchaseable by the Council. The Barking station would give bulk supplies of electricity to a number of London stations, and when these stations were purchased by the L.C.C. if the Council decided not to continue to take the supplies, they would be disconnected, and special compensation against this contingency was sought by the company. The L.C.C. opposed the Bill, and especially the clause providing for the payment of compensation on severance of connections on the purchase of the London stations. The committee, on July 29th, approved the preamble of the Bill upon the insertion of amendments guaranteeing the L.C.C. a sufficient supply when the London stations were purchased, and providing that the station should not be taken over by a Joint Electricity Authority until a period of five years had elapsed from the passing of the Bill.

Copper and Lead Prices.—Messrs. F. Smith & Co. report August 2nd: Copper (electrolytic) bars, sheets, wire rods, and h.c. wire, no change. Messrs. James & Shakespeare report August 3rd: Copper bars (best selected), sheet, rod, no change. English pig lead £25, 10s. increase.

Unemployment.—The Ministry of Labour's unemployment figures for the week ended July 22nd show another decrease. The total (men, boys, women and girls) was 1,870,000 as compared with 2,013,671 in the preceding week. The fall was evenly distributed among the four classes of workers.

Beanfeast Subscriptions to Cease.—The practice whereby manufacturers are continually being asked for subscriptions to social or athletic clubs by the employés of firms with whom they happen to do business has been under discussion in the Trade Associations. Members of at least one Association have passed a resolution pledging themselves to discontinue altogether subscriptions to beanfeasts, clubs, &c., owing to the great increase in applications.

Patent Restoration.—An order has been made restoring Patent 1902 of 1910 granted to Jules Carpentier for "an improved transmitter for transmitting telegrams composed in perforations on a band by the Baudot system."

A "Simplex" Competition.—Simplex Conduits, Ltd., recently offered a prize of five guineas for the most appropriate name for a new continuity fitting. The winning suggestion was "Terra-Grip," which fits the device very aptly.

Registration of Contractors in South Africa.—An ordinance has been passed by the Cape Provincial Council empowering the municipalities in the Cape Province to make regulations for the registration of electrical contractors and for the licensing of electric wiremen. Should any municipality neglect to make such regulations within four months of the passing of the Ordinance the power to do so becomes vested in the Administration.

The Cost of Living and Trade Revival.—In the course of his speech at the annual meeting of Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., last week, Sir Glynn West said, as reported in the *Financial Times*, that increased wages had brought about increased prices of material, with the result that the cost of everything required throughout the world became so excessive that, notwithstanding the wants of the people, orders were withheld after only most pressing requirements were fulfilled. The cost of living was now slowly declining and it was not unreasonable to hope therefore that within the next few months they might see a gradual revival in trade, but there was little chance of this unless they could have a period of freedom from industrial disputes, which benefited no one in this country, but were the greatest help to our competitors abroad. Further, while the export trade of England was of vital importance to the country as a whole, it was of special importance to them as ship-builders. A decline in export trade meant a decline in the demand for ships, and they now had to face not only a poor prospect of receiving further orders, but cancellation and suspension of orders already placed. If high wages and the cost of production were to continue in this country and not elsewhere there was little chance of orders for the manufacturers or work for employés. There were few manufacturing concerns which had not been faced with the necessity of providing further capital. If this great manufacturing country was to maintain its place among nations the world costs of production must fall, and the necessity for financing orders at excessive costs as in the immediate past would disappear. The firm had still a great deal of work in its shipyards and shops, and the acceptance of the principle that wages must vary with cost of living would greatly help it.

Commercial Travellers and the Week-end Ticket.—Considerable interest has been aroused amongst commercial travellers by the railway companies restoration of the week-end tickets as from August 19th, but much disappointment is felt that the concession does not carry with it the old-time privilege of a return ticket at a single fare, available from any station to the traveller's home station. The National Union of Commercial Travellers has been informed by the Railway Clearing House that the return ticket will be issued at a cost of a single fare and a third, and the cost of the certificates and books of vouchers necessary to obtain these tickets will be 1s. and 5s. respectively, which is exactly double the charge made at the time the tickets were withdrawn in 1916. The minimum fares for commercial travellers' week-end tickets are now to be 5s. third class, 10s. first class, and tickets will be issued as before, *i.e.*, after 12 noon on Friday, and the return journey must be made on Sunday or Monday following. Commercial travellers can obtain fuller details by writing the secretary of the Union at St. Bride's Institute, Bride Lane, E.C. 4.

Australian Telephone Orders in Arrears.—The Australian Commonwealth Postmaster-General has prepared a statement showing the amount of material on order in August, 1920, still undelivered. The most important of this is six switchboards, including two required for the exchange at Collingwood and three for Malvern. Of 217 miles of cable on order in August, 1920, only 134 miles has been delivered; 521 miles has been ordered since August, 1920, and the total of orders now outstanding is 544 miles. The position regarding wire is even worse, and 14,648 miles is now on order, awaiting delivery. In August, 1920, there were 13,699 telephone instruments on order, and 30,943 have been ordered since. Deliveries have been so few that there are still 32,871 telephone instruments undelivered. The value of the material at present on order is £1,044,261.—*Tenders.*

Forthcoming Exhibitions.—The following exhibitions are being organised:—

London.—September 7th to 28th, Shipping, Engineering and Machinery Exhibition; September and October, Textile Industries Exhibition; October 14th to 22nd, Commercial Motor Exhibition; November 4th to 12th, Passenger Motor Exhibition; November 17th to 25th, Public Works, Roads and Transport Exhibition; March 1st to 25th, 1922, Ideal Homes Exhibition.

Glasgow.—September 19th to October 8th, Ideal Homes Exhibition; November 1st to 19th, Shipbuilding, Engineering, and Electrical Exhibition.

Canada (*Toronto*).—August 27th to September 10th. Canadian National Exhibition.

Austria (*Vienna*).—September 11th to 17th, International Fair.

Belgium (*Liége*).—September 11th to 25th, International Machinery, Tools, &c., Exhibition.

Czecho-Slovakia (*Prague*).—September 1st to 8th, International Samples Fair.

France (*Lyons*).—October 1st to 15th, Metallurgy, Machinery, and Industrial Fair.

Holland (*Utrecht*).—September 6th to 16th, International Industrial Fair.

Italy (*Naples*).—September, Samples Fair.

Norway (*Christiania*).—September 4th to 11th, Norwegian Industries Fair.

Poland (*Lemberg*).—September, International Fair.

Rumania (*Bukarest*).—Samples Fair and Rumanian Exhibition.

Spain (*Barcelona*).—September 1st to 10th, International Samples Fair.

Trieste.—September 11th to 25th, International Samples Fair.

Java (*Bandoeng*).—September 9th to October 19th, Netherlands East Indies Fair.

Mexico.—September, Commercial and Industrial Fair.

Inquiry.—Makers of the "Euco" electric hand lamps are asked for.

Glasgow Ideal Homes Exhibition.—The Ideal Homes Exhibition promoted by the Glasgow Corporation will be opened in the Kelvin Hall, Kelvingrove, on September 19th, and will continue until October 8th. The exhibition will be divided into different classifications, including building materials, furnishings, lighting, heating, labour-saving and cleaning appliances, sanitary appliances, decoration, recreation, foodstuffs (prepared and preserved), and appliances for home nursing. Working exhibits and competitions, including one for amateur photographers, will add to the interest in the exhibition.—*The Times.*

Exploitation of Radium Deposits.—"Lidové Noviny," of Brno, states that an Anglo-Czecho-Slovak company is about to be formed with the object of exploiting the radium deposits near Jachymov, Bohemia. The capital of the company will be 20,000,000 crowns (about £70,000).—*The Times.*

Perth Salaries Dispute.—A stoppage of work at the Corporation electricity works has been averted. Some time ago the staff protested against a new grading arrangement, and notified the electrical engineer that if the original grading was not reverted to they intended to stop work on Thursday last week. A sub-committee, after hearing the assistant general secretary of the E.P.E.A., decided that the present system of grading and pay should be continued until the Town Council could submit the question to the Scottish District Joint Board for the Electricity Supply Industry, for its decision.

The Highland Show.—At the Royal Highland and Agricultural Show at Stirling, last week, there were a number of interesting electrical exhibits, including the "Silent Alamo" electric light and power plant shown in operation. Messrs. William Beardmore & Co., Ltd., had a small display of typical lines of their manufactures. The exhibits included a 20-b.h.p. Beardmore oil engine, direct coupled to a dynamo generating lighting energy for the stand.

New French Company.—Among the new companies recently formed in Paris are the Groupement des Compagnies d'Energie Electrique et d'Eclairage du Nord et de l'Est (94, Rue Saint Lazare), capital 1,000,000 francs; and the Société Union Hydro-Electrique, capital 38,000,000 francs.

Swedish Exports.—The value of the exports of telephone and telegraph apparatus from Sweden increased from 2,600,000 kronen in the first half of 1920 to 8,200,000 kr. in the corresponding period of 1921, and that of electrical machinery from 6,500,000 kr. to 9,400,000 kr. in the same periods respectively.

Price Reduction.—The Benjamin Electric, Ltd., of Tottenham, announce price reductions in respect of various sections of their catalogue.

The International Eight-Hour Day.—Among the conventions adopted at the International Labour Conference, held at Washington in 1919, under the auspices of the International Labour Bureau attached to the League of Nations, were those relating to the limitation of work in industrial establishments to 48 hours per week, the question of unemployment, female and child labour, and night work. It is stated that the only nations which have ratified these conventions are Greece, Czecho-Slovakia, and Rumania! Not even the United States, which inspired the conference at Washington, has fathered its offspring.

New Italian Company.—La Societa Generale di Elettricità is the name of a new company which has lately been formed in Milan with a capital of 1,000,000 lire.

German Competition in Italy.—Tenders were recently invited in Italy for the supply of hydro-electric plant. A German offer was submitted at 9,622,000 lire, including freight and duty, whereas the lowest Italian tender is stated to have been 12,600,000 lire.

Book Notices.—"Mex Fuel Oil" (210 pp.; 120 figs.). London: George Philip & Son, Ltd. Price 10s. 6d.—The utilisation of oil as fuel in the many directions in which coal is employed has become a question of first-rate importance, and any contribution to the literature of the subject is to be welcomed. This work, which has been produced by the Anglo-Mexican Petroleum Co., Ltd., covers multitudinous applications of oil in the generation of motive power. The first part deals chiefly with production, distribution, and kindred matters. The advantages obtained by the use of oil are then set otu, and following this some twenty different kinds of burners are described. The use of oil fuel for naval purposes is given some space, and its application to railway locomotives is dealt with. Chapter VII is devoted to notes on the employment of the fuel in land steam power stations, and the following chapter describes types and uses of oil-fired furnaces. In the course of Chapter IX, which is of considerable length, about 20 heavy oil engines are illustrated and described after some notes on the various classes, such as stationary and marine Diesels and semi-Diesels. In the appendices a great amount of miscellaneous information regarding fuel oil and its employment appears.

"The Henley Telegraph," Vol. 1, No. 6 (32 pp.). London: W. T. Henley's Telegraph Works Co., Ltd. Price 6d. net. In the June issue the excellent standard reached previously is maintained, and many articles of interest, both to the firm's staff and to those outside, again appear.

"The Mining Electrical Engineer," Vol. II, No. 10, July, 1921. Manchester: The Association of Mining Electrical Engineers. Price 1s. net.—In this issue are articles on the unwatering of a colliery and an overspeed device for electric winders, as well as notes on new miners' lamps, &c.

The *Journal* of the South African Institution of Engineers, Vol. XIX, No. 12, July, 1921.—This issue contains the annual report for the 1920-21 session, with a statement of accounts and balance sheet, and the retiring acting president's valedictory address.

Journal of the American Institute of Electrical Engineers, Vol. XL, No. 7, July, 1921 (74 pp.). New York: The Institute. Price $1.—Including notes on hydro-electric development at Niagara Falls, the magnetic properties of compressed powdered iron, &c.

The Journal of Industrial Welfare, Vol. 3, No. 7, July, 1921 (29 pp.). Price 9d.—The principal article in this issue is "The Enlightened Employer," by Mr. William Graham, LL.B., the Labour M.P. for Central Edinburgh. Miss Lily Dormald contributes an article on canteen service, and there are notes on "Health in the Workshop," works magazines, &c.

For Sale.—F. Hudson & Co., Ltd.—Mr. W. E. Harris, of 88-90, Chancery Lane, London, W.C. 2, who was appointed receiver and manager for the debenture holders in February last, has announced to the creditors that the debenture holders, the London Joint City & Midland Bank, Ltd., have now decided to foreclose, and instructions will be given for sale by auction next month, but in the meantime he is open to receive offers for sale by private treaty. Parts of the machinery and stock have been sold for cash.

By direction of the Disposal Board, Messrs. Geering and Colyer will sell by auction on August 19th at the seaplane shed, Dover, a quantity of machine tools, electric cranes, generating sets, electric motors, &c. For particulars see our advertisement pages to-day.

The Holidays.—The offices and works of Messrs. Wilson Hartnell & Co., Ltd., of Leeds, are closed for the annual holidays until Monday next, August 8th.

Annual Outings.—On Saturday, July 23rd, The Elco Electric Manufacturing Co., Ltd., of Bristol, held its annual outing, the staff and employés and a few visitors journeying by charabancs to Minehead. At the dinner, which was served there, Mr. Fifield and Mr. A. C. Wiley, managing director, were the speakers. The latter said that orders for "Elco" manufactures had been recently received from abroad. Sports were engaged in on the Minehead Sports Committee's ground. Tea was partaken of at Greenaleigh Farm on the North Hill, after which Mrs. Fifield presented the sports prizes. Supper was served on the homeward way, at the "Fox and Goose," Brent Knoll.

LIGHTING AND POWER NOTES.

Accrington.—Proposed Loan.—On July 26th, Col. Elkin held an inquiry into an application of the Corporation for sanction to the borrowing of £150,000 for electricity extensions. It was stated that the debt on the electricity undertaking was £155,835. The importance of the electricity extensions was emphasised by the Town Clerk, and it was stated that the Corporation had been recommended to install a 6,000-kW set and four 25,000-lb. steam boilers. Mr. Blackmore (Stalybridge) calculated that if Accrington obtained the additional electricity from Blackburn at the price quoted by the latter, it would cost Accrington £10,000 a year more than producing it under the present scheme. There was no opposition.

Amesbury.—Electric Light Scheme.—Messrs. Edmundsons and the Salisbury Electric Co. have arranged to carry out an electric light scheme for the parish, and to utilise water power from a local mill. Power will be transmitted by overhead wires, and a committee has been formed to secure £2,500, half the capital needed.

Bangor.—Loan.—The Urban District Council has applied for sanction to borrow £4,630 for the installation of a 100-kW Diesel engine set at the electricity works.

Barrow.—Negotiations with Large Consumers.—At a Town Council meeting on July 25th, the Electricity Committee reported upon the electricity works extensions and proposed new power house. They had considered reports from the electrical engineer and the treasurer, and resolved: "That the deputation appointed by this committee continue their negotiations with Messrs. Vickers, Ltd., with a view to obtaining from them a guarantee of a minimum consumption of electricity in the event of the Corporation purchasing their Cavendish Park Power House, and that the Barrow Hematite Steel Co., Ltd., the Barrow Paper Mills, and other large consumers be approached with a view to securing their custom for an extended number of years."

Brighton.—Year's Working.—The statement of accounts of the Corporation electricity undertaking for the year ended March 31st last records a total income of £190,019, as compared with £158,062 in the preceding period. The working expenses totalled £129,719, as against £105,755, leaving a surplus of £60,300 (£52,307). The net financial result, after providing for interest and sinking fund, was a profit of £11,859, as against £13,374 in 1919-20. The number of units sold rose from 11,002,835 to 11,261,408. The plant capacity at the end of the year was 12,500 kW, and the maximum load during the period was 6,286 kW. The amount of coal consumed per unit generated improved from 5.27 lb. to 4.21 lb.

Continental.—Finland.—The British Vice-Consul at Wiborg says that the Imatra group of rapids, which constitutes one of the largest water powers in Finland, is capable of giving 150,000 h.p. when fully developed. Very little has been done in this direction up to the present. There is a 1,300-h.p. plant at Linnankoski which is employed upon metal production. There are also other plants at Tainienkoski, Raikelankoski and Imatra; the first two are connected with the wood pulp industry, while the other is a small lighting plant of about 125 h.p. Plans have been drawn up or are projected for the development of a number of other rapids.

Iceland.—*Berlingske Tidende* learns from Reykjavik that the new electricity works which have just been opened contain two generators, one developing 1,000 h.p. and the other 500 h.p. These machines are driven by the comparatively small stream of the Ellideraa, a few kilometres outside the town of Reykjavik. In spite of the cost of the works (nearly Kr. 3,000,000) it has been found possible to supply the town with electricity more cheaply than heretofore. The works can easily be adapted to produce double the power, and it is expected that this extension will soon become necessary. The works at Reykjavik represent but a fraction of the power which could be obtained from the great Icelandic falls. Two water power companies exist on the island at present, one Danish-Icelandic, the other Norwegian-Icelandic.—*Reuter's Trade Service* (Copenhagen)

Rumania.—The *Financial Times* states that arrangements have been completed between the Steaua Romana Co. and the Electricity Supply Co. for the establishment of a new generating station at Baicoi. A company with a capital of 20,000,000 lei is being formed to give effect to the new development. This company, which it is expected will be in working order in the autumn, will supply power for oil wells in the district which require it, and will, it is calculated, prove a great boon to the companies operating both in the Baicoi and Ploeshti areas.

Russia.—A Russian paper quotes a decree, signed by Lenin, on the centralisation of electricity in Russia, which affects the various electrical stations and distributing systems, excepting tramways, in order to centralise the management and control which passes into the hands of the Superior Council of Public Economy, which exercises its powers in other parts of Russia than Moscow, through the medium of the local councils. In Moscow all the stations are to be brought under the direct control of one administration.

With regard to provincial electrification, the *Isvestyia* says that the Perm Government Union of Councils has appointed a special commission to deal with the electrification of the whole agricultural industry of the Perm Government. A similar step is being taken by the Uphim Government.

In the Yaroslav Government at the central station of the town, the installation of a three-phase turbo-generator, with a capacity of 2,000 kW, is being completed, raising the power of the station to 3,200 kW. A plan is being prepared for the electrification of the whole Government of Yaroslav with a central station of 10,000 kW capacity on the Yaroslav peat-marshes.

The demand for power this year in the district of Nizhni-Novgorod has been about 1,500 kW. to satisfy which, work is proceeding to combine a number of stations which will supply 2,000 kW next year. A similar operation is being undertaken in order to supply the Kolomensk Engineering Works with the electricity they require, by joining up several other stations to bring the output up to 3,000 kW.

France.—As a result of the fall in the price of coal, a reduction in the prices charged by the Compagnie Parisienne de Distribution d'Electricité has been made.

Edinburgh.—Prospective Capital Expenditure.—Capital expenditure amounting to £1,068,000 will be incurred this year by the Corporation electricity department, principally in connection with the new Portobello station.

Erith.—Loan.—The electrical engineer having reported that the cost of the necessary cables, transformers and switchgear in connection with the supply to Messrs. Vickers, Ltd., will be about £10,000, application is being made for sanction to borrow this amount.

Electricity Districts.—East Midlands.—The Electricity Commissioners give notice that they have extended the time within which objections and representations may be made, or schemes submitted, in connection with the above-named district from the last day of July to October 31st, 1921.

Mid-Lancashire.—A similar extension of time (until October 31st, 1921) has also been made in the case of the Mid-Lancashire district.

Hoylake.—New Sub-station.—After examining a report presented by the electrical engineer, the Electricity Supply Committee of the Hoylake and West Kirby District Council has decided to erect a sub-station at Meols at an approximate cost of £483.

Ipswich.—Year's Working.—The accounts of the borough electricity undertaking for the year ended March 31st, 1921, show a total income from all sources of £90,854, as compared with £75,311 in the preceding period. The total working expenses were £61,682, as against £51,804, leaving a balance of £29,172 (£23,507). The net result, after payment of all capital charges, &c., was a profit of £7,981, which was transfered to reserve, as against £5,838 in the previous year. The number of units sold increased from 5,812,921, in 1919-20, to 7,174,805.

Joint Electricity Authorities.—Chester and North Wales.—The Electricity Commissioners have informed the Electricity Committee of the Chester Corporation that it is preferable for the provisional committee for the North Wales and Chester Electricity District to be constituted locally, and they suggest that the town clerk and the managing director of the North Wales Power & Traction Co., shall issue a joint letter to the parties concerned, and bring about the formation of a committee. Both parties have agreed to the adoption of the recommendation. The Provisional Committee will be constituted of a representative of the North Wales Power & Traction Co., the chairman of the Electricity Committee of each local authority operating under its own Electricity Orders, the district superintendent of the L. & N.-W. Rly. Co. the chairman of the North Wales Slate Quarries Association, and the chairman of the North Wales Coal Owners' Association.

Leicester.—Proposed Price Increase.—The City Council is asked to sanction an increase of 33⅓ per cent. in the charges for electricity, making an increase of 133⅓ per cent. upon pre-war prices. This is necessary to cover a deficiency of £14,540, occasioned by the coal stoppage.

Extensions.—The Finance Committee has approved the expenditure of £125,000 on transformers, switchgear and cables.

Leek.—Loan.—The Electricity Committee recommends application to the Electricity Commissioners for sanction to borrow £18,500 for the provision of additional plant at the electricity works.

Middlesbrough.—Proposed Extensions.—The Electricity Commission has written the Corporation with reference to the Electric Lighting Order of 1898, enclosing formal consent to the extension of the generating station. The Commissioners add that they are of the opinion that the Corporation should negotiate with the Cleveland and Durham County Electric Power Co., with a view to arrangements being made for the company to supply the whole of the energy required by the Corporation for the district. Such an arrangement, they point out, would enable the Corporation to dispose of its steam plant, retaining only the gas engines as stand-by plant. The Commissioners are further of opinion that it would be a mistake on the part of the Corporation to install further plant in its generating station, and, as the demand for electricity in the borough is increasing each year, the Corporation will therefore sooner or later require to arrange with the Power Co., for additional supplies of energy. In these circumstances, the Commissioners suggest that steps should be taken by the Corporation to arrange for further supplies being available from the Company to meet further demands before the existing agreement between the Corporation and the Company expires. The borough electrical engineer says that it would not be in the interest of the department to dispose of the plant as suggested. They had installed to meet the winter peak load 1,500 kW of steam plant, and to replace this plant by rotary converters would require at least three 700 kW sets. These, complete with switchgear, transformers and cables, &c., would cost approximately £8,000 each, a total of £24,000.

The Corporation has written the Electricity Commissioners pointing out that it has an existing arrangement with the Cleveland and Durham County Electric Power Co. for a period of six years, and that it would be uneconomical to put in rotary converters, and that it does not therefore consider it advisable to dispose of the steam plant.

New Power Station.—In connection with the development of the north bank of the Tees in the neighbourhood of Middlesbrough and Stockton, the Cleveland & Durham Electric Power Co. is ensuring an adequate supply of power by the erection of a large generating station on a site of about 60 acres. The station is designed for 54,000 h.p., and in the lay-out of the site provision has been made for doubling the capacity.

Northampton.—Price Reduction.—The E.L. & P. Co., Ltd., announces that from the midsummer meter readings the initial price of electricity for power will be reduced by ½d. per unit, and that the additional discount to high-pressure consumers for fully equipping their own transformer chambers will be increased by 5 per cent.

Norwich.—Year's Working.—The accounts of the city's electricity undertaking for the year ended March, 31st last, record a total revenue of £135,499 as compared with £114,221 in 1919-20. Working expenses amounted to £94,692, as against £71,322, leaving a gross balance of £40,807 (£42,899). After the payment of capital charges the sum of £13,668 was carried to the appropriation account; £20,972 was transferred in the previous year. The number of units sold increased by 4.38 per cent. to 10,943,222. The report states that it will be necessary to install additional boiler plant to meet next winter's load. The erection of a new station has been deferred on account of the depressed state of trade.

Paisley.—Year's Working.—The total revenue of the burgh electricity department for the past financial year was £86,500 as compared with £64,254 in the preceeding year. Working expenses amounted to £51,775, as against £42,699, leaving a gross profit of £34,725 (£21,255). After paying capital charges, &c., a net profit of £7,796 remained. The profit in 1919-20 was £745. This is the second consecutive large increase in net profit as there was a deficit, in 1918-19, of £14,275. The number of units sold during the year was 6,683,088, an increase of 799,113. It was stated at a meeting of the Council that a sum of £3,000 was to be taken from the electricity department's surplus to help to meet a deficiency incurred by the gas department.

Peterborough.—Proposed Extension of Area.—The City Council is considering making an application for an order authorising an extension of the area of supply defined in the Peterborough Electric Lighting Order, 1894. It is proposed to include about twenty additional parishes.

Seaham Harbour.—Offer of Supply.—The Urban District Council has received a communication from the County of Durham Electrical Power Distribution Co., Ltd., offering to negotiate for the supply of electricity in bulk in the event of the Council carrying out its proposal to apply for Parliamentary powers to provide the area with electricity for lighting and other purposes.

Shrewsbury.—Year's Working.—The total revenue of the electricity undertaking for the year ended March 31st last, was £20,988, as compared with £16,821 in the previous year. Working expenses amounted to £17,550, as against £12,617, leaving a gross profit of £3,438 (£4,203). The net result was a deficit of £192; there was a net profit of £713 in 1919-20.

South Africa.—Pretoria.—The *South African Mining and Engineering Journal* states that Pretoria has decided to install a new and up-to-date lighting and power plant, costing upwards of £300,000. In accordance with the latest power station practice, a steam pressure of 350 lb. has been adopted, which will ensure very low fuel costs. The power plant will consist of three turbo-alternator sets of 3,000 kW each, the order for which has been placed with the British General Electric Co., Ltd., of Johannesburg. The boiler plant order has been secured by Messrs. Reunert & Lenz for Babcock and Wilcox boilers.

South Shields.—Loan Sanctioned.—The Electricity Commissioners have sanctioned a loan of £1,890, for boosting plant.

Stoke-on-Trent.—Loans.—Application is being made by the Council for sanction to borrow £200,000 for extensions to the main station previously approved.

The Electricity Commissioners have approved loans of £10,000, for plant at the central station, and £1,400 for building extensions at the Burslem sub-station.

Stafford.—New Method of Charging.—In consequence of a report by a consultant, the Town Council has decided to terminate at the end of the September quarter, the existing methods of charging for electricity and to institute a differential system.

Wolverhampton.—New Plant.—The Electricity Committee recommends the provision of an additional 5,000-kW set at the Commercial Road generating station, and the consequent

extension to equipment, alterations to buildings &c., at a total estimated cost (including an amount for contingencies), not exceeding £136,000.

Willesden.—Charges on Fuel Basis.—At a meeting of the Electricity Committee, the electrical engineer reported that he had agreed with the North Metropolitan Electric Power Supply Company as to the basis to be adopted in calculating the average cost of fuel during the past quarter in view of the circumstances then prevailing, and the substitution of coke and fuel oil for coal. The principle adopted provides for the reduction of coke and fuel oil, in relation to their calorific values, to their equivalent values in tons of coal, and the committee recommends that this method of calculating the amount payable by the Council in respect of fuel during the past quarter be approved.

TRAMWAY AND RAILWAY NOTES.

Australia.—Electrification of Victorian Railways.—It is announced that the Victorian Railway Commissioners are about to convert a further 100½ miles of their lines from steam to electric traction and that the work is to be completed by the end of February, 1923. In addition to this electrification, which covers the passenger-carrying routes, a number of lines exclusively used for goods traffic are to be converted and the electric system extended over several of the busier sections of the country lines. This work will entail the overhead wiring and rail bonding of considerably over 100 miles of track, the erection of a number of sub-stations additional to those already in use, the replacement of the existing signalling services, and the construction of several workshops fully equipped with all types of machine tools. It is proposed that Australian materials shall be used to the fullest extent.—*Times Trade Supplement.*

Barnsley.—Charging Plant.—The Town Council has received sanction to a loan of £9,000 for charging plant for the electric collecting vehicles.

Dover.—Time Extension.—The Light Railway Commissioners have extended the period for carrying out the Dover and St. Margaret's Light Railway Order to October 9th. It is stated that the scheme has been in hand for about twelve years, having been interrupted by the war.

Halifax.—Railless Traction Report.—The Tramways and Electricity Committee has received from the Director-General, Public Safety and General Purposes Department of the Ministry of Transport, a report by Major A. Mount, R.E., on his inspection of the railless traction route at Wainstalls, authorised by the Halifax Corporation Act, 1915. Attention is drawn to repairs needed in the roadway, and the report suggests that the Corporation will find a good deal more work necessary in the near future if repair charges on the vehicles are to be maintained at an economic level. Attention is drawn also to the fact that at one stretch the road is only from 14 ft. 6 in. to 17 ft. wide, involving passing vehicles using the footpath on the east side, where the property belongs to the Corporation, and it is recommended that the road be widened there to a minimum of 20 ft. The Committee has decided to recommend the Highways and Improvement Committee to carry out these requirements at an early date.

Ipswich.—Year's Working.—The total revenue of the Corporation tramways during the year ended March 31st last was £50,341, and working expenses were £51,942, leaving an adverse balance of £1,601. The equivalent figures for the previous year were £47,954, £46,387, and (gross profit) £1,567. The net result, after payment of capital charges, &c., was a deficit of £7,802; last year's deficit amounted to £4,151. The number of car-miles run fell from 667,260 to 652,420, although the number of passengers carried increased slightly.

Japan.—Elevated Railway for Kobe.—An elevated electric railway, with quadruple lines 7½ miles in length, is being planned for Kobe by the Town Planning Committee of Hyogo Prefecture. In the city proper, beneath the elevated line, a road for vehicles and pedestrians will be built. In the suburbs, embankments and roads will be built parallel to the tracks, and streets varying from 36 to 144 feet wide will be built in all directions from the new track. The rails and other materials for the electric line will be purchased partly in the United States and partly in Europe.—*Reuter's Trade Service* (Kobe).

Electrification of Kobe Railway.—Orders have been placed with American manufacturers by the Kobe Railway Bureau for 12 electric locomotives at a price of approximately 130,000 yen each, which is from 20,000 to 30,000 yen more than the present steam locomotives are costing the Railway Bureau. These electric locomotives are the first to be ordered in connection with the execution of the plan for electrifying the main line railway between Kobe and Tokio. The first section of the line to be so transformed is that between Akashi and Kyoto. Overhead wires will be erected shortly. The cost of putting up these wires between Osaka and Kobe is estimated at 500,000 yen. The electrification of this section of the railway has been contemplated for some time, but operations have been held in abeyance because of a lack of electricity in this part of the country. This has been remedied, however, and operations will commence at once.—*Reuter's Trade Service* (Osaka).

London.—Improved "Underground" Rolling Stock.—The Metropolitan Railway Co. has put into service some of the locomotives which are being reconstructed by Messrs. Vickers. These each have four 300-h.p. series-wound traction motors transmitting power to the axles through single reduction gearing and controlled by all-electric automatic multiple units.

North Shields.—Accident.—A serious accident occurred at North Shields on August 1st. A crowded tramcar was proceeding down Borough Road, a steep incline, and, while rounding a curve, overturned. Five passengers were killed and nine seriously injured; about twenty others also sustained injury. This is the third accident which has occurred at this spot.

Sheffield.—Strike Averted.—A majority of eight averted a lightning strike of tramway workers on Monday over a dispute which arose about working hours.

TELEGRAPH AND TELEPHONE NOTES.

Brazil.—Cheap Telegraphic Facilities.—Marconi's Wireless Telegraph Co., Ltd., announces that ordinary and deferred messages can now be accepted for transmission *via* its trans-Atlantic wireless system to Brazil at rates lower than those charged for transmission by cable.

Italy.—New Cable.—A Bill authorising a concession to lay a cable between Italy, Spain, Brazil, Uruguay, and the Argentine was introduced at Rome on July 23rd.

Russia.—Telegraph Concession.—*The Times* reports that the Russian Soviet Government has granted a concession for telegraphic connection between Russia, Denmark, Japan and China to a Scandinavian company (probably the Great Northern Co., which has been for some time in negotiation with the Russian Government over such a concession).

Sweden. — Telegraph Revenue. — The Telegraph Board's annual report for 1920 shows an increase in revenue of Kr. 20,000,000, making a total of Kr. 90,000,000. This increase is due to the raised fees, but expenses are also higher. The net profit works out at Kr. 10,500,000.—*Reuter's Trade Service* (Stockholm).

The Telegraph Service.—Press Messages.—The Postmaster-General announces that from August 1st, Press telegrams at reduced rates for Belgium, France, Germany, Holland, Norway, and Spain will be accepted at post offices on the usual conditions between the hours of 6 p.m. to 12 noon. Such telegrams for Denmark and Sweden will, on and from the same date, be accepted between 6 p.m. and 11 a.m. The deferred Press service at the rate of 4½d. per word was restored on the same date between the U.K. and Australia, New Zealand, and Fiji, "*via* Imperial and Pacific only."

The Telephone Service.—Select Committee.—The Select Committee appointed by Parliament to inquire into the telephone service concluded its hearing of evidence on July 28th, and agreed to an interim report stating that it had been unable to complete its inquiry, and asked that it should be reappointed next session. The evidence taken during the 26 meetings of the Committee this session is to be published. The chairman of the Committee (Mr. Evelyn Cecil) accompanied the Committee's expert adviser (Mr. W. W. Cooke) on his visits to Norway, Sweden, and Denmark, where they investigated the systems operated in those countries. They left on July 30th, and Mr. Cooke will afterwards proceed alone to Canada and the U.S.A. The foreign Governments concerned have agreed, through diplomatic channels, that all facilities for investigation shall be given, says the *Financial Times*.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—Sept. 28th. Victorian Government Railways. Lifting magnet and generating set with control apparatus and accessories. (Contract No. 34,241.)*

Queensland. — P.M.G.'s Department. — November 5th. Bronze wire, Schedule 536. (July 29th.)

Barking.—August 9th. Electric lighting at new Special Subjects Centre. C. J. Dawson, architect, Clock House, Barking.

Belfast.—August 22nd. Electricity Department. One 12,500-kW turbo-alternator, with condensing plant and auxiliaries. Four water-tube boilers, with superheaters and forced-draught fans. Four fuel economisers. Two steel chimneys, with four electrically-driven suction draught fans. One electrically-driven centrifugal pump, capacity 18,000 g.p.m. (July 22nd.)

Bristol.—August 15th. Corporation Electricity Department. One 3,000-kW, single-phase, 93-cycle, 2,200-V turbo-alternator and condensing plant and auxiliaries; one 6,000-kw, three-phase, 50-cycle, 6,600-V ditto. (July 15th.)

Coventry.—September 1st. Electricity Department. Two 10,000-kW, 3-phase turbo-alternators, complete with condensing plant; four water-tube boilers with chimneys, superheaters, mechanical stokers, economisers, and all accessories. (August 29th.)

Edinburgh.—August 29th. Corporation. Open cuttings and tunnel between the power station site and coal sidings site, including the construction of a coal bunker and access, and the earthworks for coal sidings and the laying of permanent way and ballasting for same (Spec. No. 37).—Electrical Engineer, Dewar Place, Edinburgh.

Glasgow.—August 8th. Corporation. Electric lighting installation at Merklands Cattle Wharf, Partick. Burgh Electrical Engineer, 75, Waterloo Street, Glasgow.

London.—L.C.C.—September 5th. H. & L.P. switchgear for sub-station. (See this issue.)

Londonderry.—August 12th. County Council. Electric lighting installation in the County Council Offices in the Courthouse. Mr. T. B. Adams, Secretary to the County Council, County Courthouse, Londonderry.

New Zealand.—Wellington.—November 1st. Public Works Tender Board. One 200/250-b.h.p. oil engine and one 3-phase, 50-cycle, 190-kW at .8 power factor, alternator, with exciter and switchgear.*

Rawcliffe, near Goole.—August 13th. West Riding Mental Deficiency Act Committee. Overhauling accumulators at Rawcliffe Hall Institution. West Riding Architect, County Hall, Wakefield.

South Africa.—Rand Water Board. September 28th. Contract No. 203. Tenders for supply, delivery, and erection at the Board's Intake Pumping Station, Transvaal Bank of Vaal River at Vereeniging of (1) Two vertical spindle centrifugal pumps, direct-coupled to electric motors, with all accessories, and (2) one 10-ton travelling crane. Also for main pumping station site, Vereeniging, two horizontal spindle centrifugal pumps, direct-coupled to electric motors, with all accessories.*

Durban. August 10th. Corporation. Supply and installation of superheaters and motor-driven mechanical stokers to three existing water-tube boilers at the Corporation Power Station, Alice Street, Durban.*

Durban. September 28th. Corporation. Two 500-kW rotary converters, switchgear, and automatic controlling devices, also h.p. supply feeders.*

Sale.—Urban District Council. Cables, transformers, switchboards, house meters, and a.c. motors. (See this issue.)

South Africa.—Pretoria.—October 4th. Electric Light & Power Department. Coal-handling plant, 6,600 V cables, induced draught and ash-handling plant, pumps, piping, &c.—Mr. T. C. Wolley Dod, General Manager, Municipal Electricity Supply, P.O. Box 423, Victoria.

Stockton-on-Tees.—August 31st. District Fund, Gas and Electricity Committees. Articles and stores for six months. (See this issue.)

Uruguay.—September 19th. Board of State Electrical Stations. Generating plant for four electrical groups, consisting of a.c. and d.c. generators, Diesel engines, &c.*

*** A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.**

CLOSED.

Belgium.—Three concerns competed for the recent Belgian Post and Telegraph Department contract for the supply of a quantity of telephonic commutators working in conjunction with a central battery. The lowest quotation was that of the New Antwerp Telephone and Electrical Works Co., of Berghem, Antwerp.

Bury.—Messrs. James Hill & Son have received the contract for installing the electric light in the parish church schools.

Glasgow Corporation (Tramways Department). Accepted:—

E.H.P. cable.—British Insulated and Helsby Cables, Ltd.
V.I.R. cable.—Johnson & Phillips, Ltd.; Liverpool Electric Cable Co., Ltd.; Siemens Bros. & Co., Ltd.
D.C.C. wire.—London Electric Wire Co. and Smiths, Ltd.
Brake chains.—Weldless Chains, Ltd.
Black adhesive tape.—C. D. Stewart, R. D. Taylor & Co.
Oilless trolley bushes.—Fleming, Birkby & Goodall, Ltd.

Grimsby.—Electricity Committee. Accepted:—

E.H.P. switchgear for the new West Marsh and Riley Street sub-stations, £1,386.—Metropolitan-Vickers Electrical Co., Ltd.
D.C. switchgear, £1,224.—Bertram Thomas, Ltd.

Government Contracts.—The following Government contracts were placed during June, 1921.

Admiralty Contract and Purchase Department.

Batteries and spare cells.—Fullers United Electric Works, Ltd.
External electric lighting.—G. E. Taylor & Co., Ltd.
Electric fuses.—L. Weekes, Ltd.
Insulating materials.—Attwater & Sons; Birmingham Mica Co.; Ioco Rubber & Waterproofing Co., Ltd.; Micanite & Insulators Co., Ltd.; J. North, Hardy & Sons; R. Whiffen.
Sheet mica.—Micanite & Insulators Co., Ltd.
Switchgear.—Metropolitan-Vickers Electrical Co., Ltd.
Wireless apparatus, condensers.—Dubilier Condenser Co., Ltd.

War Office.

Electric cables.—W. T. Henley's Telegraph Works Co., Ltd.
Electric cells.—Ever Ready Co. (Great Britain), Ltd.
Miscellaneous electrical equipment.—Newton Bros., Ltd.
Feeder units (600 kVA).—Johnson & Phillips, Ltd.

Air Ministry.

Re-erection of batteries.—Hart Accumulator Co., Ltd.
Ignition cable.—Siemens Bros. & Co., Ltd.
Magneto spares.—Lucas Electric Co.
Magneto spares.—E.I.C. Magneto Co., Ltd.
Switchboards.—Erskine, Heap & Co., Ltd.

Post Office.

Protective apparatus.—S. G. Leach & Co., Ltd.; Phœnix Telephone and Electric Works, Ltd.; Reed Bros., Engineers, Ltd.; H. W. Sullivan; Western Electric Co., Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L.M. Ericsson Manufacturing Co., Ltd.
Telegraph and telephone cable.—Pirelli General Cable Works, Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Compound.—Dussek Bros. & Co., Ltd.
Conduit.—J. McDougal, Ltd.
Ebonite.—North British Rubber Co., Ltd.
Indicator lamps.—A. C. Cossor, Ltd.
Laying conduits.—Manchester (High Street area, first section): Chandler Bros.. Burdett Road (Baggalay Street, Mile End Road): J. A. Ewart, Ltd. Streatham-Mitcham: G. J. Anderson. Great Yarmouth (H.P.O.-Fish Wharf B.O.): R. J. May. Kilmarnock-Hurlford: W. Dobson.
Manufacture, supply, drawing-in, and jointing of cable.—London-Uxbridge and Bristol-Newport: W. T. Henley's Telegraph Works Co., Ltd.
Power plant.—Northolt—Medium power wireless station: C. F. Elwell, Ltd. Sub-contractors: Electric Construction Co., Ltd.; Submersible Motors, Ltd., for motor-generator sets; W. H. Allen, Sons & Co., for oil engine; Allen, West & Co., for switchboard equipment.
Telephone equipment.—Grimsby: Siemens Bros. & Co., Ltd. Rusholme: Western Electric Co., Ltd; North-Eastern Marine Engineering Co., Ltd.; Relay Automatic Telephone Co., Ltd. Sub-contractors: D.P. Battery Co., Ltd., for batteries. Penarth: Peel-Conner Telephone Works, Ltd. Sub-contractors: Tudor Accumulator Co., Ltd., for batteries; Crompton & Co., Ltd., for generator charging set.

Crown Agents for the Colonies.

Cable.—Callenders Cable & Construction Co., Ltd.
Electrical materials.—Callenders Cable & Construction Co., Ltd.
Electric motors and switchgear.—Metropolitan-Vickers Electrical Co., Ltd.
Electric transformers.—English Electric Co., Ltd.
Osram lamps.—General Electric Co., Ltd.
Storage battery.—Pritchett & Gold & Electrical Power Storage Co., Ltd.
Telegraph line material.—Bullers, Ltd.; Siemens Bros. & Co., Ltd.
Telephones.—British L.M. Ericsson Manufacturing Co., Ltd.
Telephone materials.—Western Electric Co., Ltd.
Copper wire.—T. Bolton & Sons, Ltd.; British Insulated & Helsby Cables, Ltd.

H.M. Office of Works.

Engineering services.—Acton Ministry of Pensions. Cable: Pirelli-General Cable Works, Ltd. Electric wiring: J. Clarke & Co., Ltd. Kew, Head Insurance Office.—Switchboard: General Electric Co., Ltd.

London.—L.C.C.—The Council, on the recommendation of the Highways Committee, has accepted the tender of Messrs. Brown, Boveri & Co. for an 8,000-kW turbine in connection with the Greenwich power station extensions; the value of the contract is £45,000. The English firms were asked recently to amend their tenders on the understanding that they could obtain their raw material abroad, and revised tenders were accordingly submitted. It is stated that the difference between the English and Swiss tenders amounted to between £6,000 and £7,000.

Mr. Hirst, of the General Electric Co., Ltd., writing to the *Daily Express*, states that the saving of £7,000 is chimerical, and maintains that the country loses £25,000 by the work going abroad—£15,000 to £18,000 in direct wages to engineering trades and probably another £10,000 in wages spent on raw materials. He says that the only benefit to the British manufacturer will be the prospect of a higher rate of contribution to the unemployment funds.

Stafford.—Town Council.

Supplying and laying 2,700 yards h.p. cable, £3,361.—Siemens Bros. & Co., Ltd.
Electrically-driven screening apparatus for the Sewage Works, £7,591.—S. S. Stott & Co.

Tramways Committee.

Two ventilated motors, £620.—English Electric Co., Ltd.
Single-deck Leyland motor omnibus, £1,650.—Leyland Motors, Ltd.

St. Marylebone. Recommended:—

Circulating water pipes in connection with the 8,000-kW Oerlikon set, £298.—Davies & Slack, Ltd.
One 120 cb. ft. air compressor, belt driven, with extended shaft for gearing, £171.—Lacy-Hulbert, Ltd.

Salford.—River Irwell Conservancy Committee. Accepted:

Electrically-driven screening apparatus, &c., £7,591.—S. S. Stott & Co.

Electrically-propelled Ships.—The electric drive will be a feature of the ss. *San Benito*, 3,625 tons, which was launched at Belfast recently by Messrs. Workman, Clark & Co., Ltd., to the order of the Unifruitco Steamship Co., Ltd. The engines, constructed by the British Thomson-Houston Co., Ltd., derive steam from three large cylindrical boilers, supplied and fitted by Workman, Clark & Co.—*Daily Telegraph*.

NOTES.

The "Electrical Review" Index.—The Index to Vol. lxxxviii of the *Electrical Review* is now ready, and will be supplied for 6d. post free on application to the Publisher, Electrical Review, 4, Ludgate Hill, E.C.4.

Appointments Vacant.—Stocks and stores clerk (£150+) for the Wigan Corporation Tramways and Motors Department; shift officers at the Government wireless station at Abu Zebal, near Cairo (44s. + war bonus, approx. £6 4s. a week). See our advt. pages to-day.

Institution of Electrical Engineers.—Meeting Days and Hours of Meetings.—The Council has decided that, beginning with next session, the meetings will be held on alternate Thursdays (except at times of public holiday), beginning with the first Thursday in November. The Council has at present under consideration the question whether the meetings should continue to begin at 6 p.m., as has been the case during the last few years, or whether the former hour of 8 p.m. should be reverted to.

Lead-Eating Ants.—Officers of the Australian telephone repair service, seeking a fault which, after the rains, had interfered with 59 telephones on the Young exchange (New South Wales), made the unique discovery of white ants among the wires in an underground cable. A cable buried 18 in. was found to contain a hole the size of a small pea, and indications pointed to the conclusion that white ants had eaten through the lead, causing the leak. When laid down each separate wire was wrapped in paper; the whole of the wires were also wrapped in paper, and encased in lead weighing 7 lb. to the sq. ft. The lead was covered with soft paraffin, and then the whole cable was covered with timber which had been specially treated with arsenic and tar. The paper inside the cable was eaten by white ants. This is believed to be the first occasion upon which white ants have been known to bore through the telephone cables in this State, though a parasite known as "the borer," in Queensland, is said to have often caused similar trouble, and in an article contributed to *The Post Office Electrical Engineers' Journal* in 1913, signed by J. M. C., the initials of Mr. Crawford, State engineer of the Telephone Department, interesting details of other cases are recorded. Mr. Crawford mentions a case in the north where a white ants' nest reached 32 ft. up to the telegraph wires, which they proceeded to enclose, effectively earthing the wire. That the white ant would be able to eat its way through the lead covering of telephone wires was, however, not suspected until a case came to light in Adelaide in 1911. The lead-covered wires were enclosed in an earthenware duct, and it was found that the lead sheathing had been badly eaten away in many places over a distance of 20 ft. The ducts had been laid on a bed of 4 in. of concrete, and both sides and top were protected by concrete 3 in. thick. However, investigation showed that there was a crack in the concrete, and through this crack the ants had apparently worked their way. As the duct was just below the asphalt pavement sufficient heat would penetrate to encourage the ants to multiply. As the termites had been found in more than one manhole, the possibility of other sections of the lead sheathing being similarly pitted necessitated prompt action. The ends of the ducts were sealed with clay, and fumes of carbon bisulphide were pumped through. Even a white ant that lived on a diet of lead could not survive this poison gas. Since then, however, white ants have been found in cable conduit in Perth, and the termites attacked the lead sheathing of a tramway feeder cable enclosed in wood troughing in Sydney.

Why does the white ant like lead as an article of diet? And how does he manage to eat it? The answer to the first question is that it is the white ants' instinct to bore through anything it finds, and the second question is answered in Mr. Crawford's article by the statement of his belief that the termite does not bite the lead at all. It was at first thought that the lead sheathing had been destroyed by the cutting action of the insect's mandibles; but subsequent analysis tended to show that the damage was probably caused by formic acid deposited on the cable sheathing by its operations. One might almost say that the white ant does not bite his lead, but predigests it by sugaring it with formic acid. There is one hopeful aspect of the matter—no white ant will be able to eat the wireless telephone.—*Sun.*

British Engineering Standards Association.—The British Engineering Standards Association held its third annual meeting on July 14th at the Institution of Civil Engineers, when the chairman, Sir Archibald Denny, Bart., presented his annual report and reviewed the position. The meeting was well attended, some 80 members being present, and a number of useful suggestions were made. The accounts, as recently adopted by the main committee, were duly presented and passed, and Messrs. Deloitte, Plender, Griffiths & Co. were reappointed auditors for the ensuing year. The chairman's address showed that there are now more than 1,500 engineers who give their time and experience to this national work, often at great personal expense and inconvenience. It must, however, be said that the business community is not as impressed as it should be with the commercial value of standardisation, otherwise the Association would not have so much difficulty each year in raising the comparatively small sum required for this work, which is of such value to the trade and commerce of the country. Last year £15,000 only was expended, of which the industry of the country contributed about £10,000, the remainder being in the nature of grants from H.M. Treasury and the Indian and Dominion Governments.

The Chairman briefly touched on many aspects of the work in its connection both with home and export trade. He emphasised the progress made and the important development in the electrical work. In glancing at the work abroad, he mentioned that there were now eleven local Committees actually at work, continually making valuable suggestions to the Home Committee.

Fatalities.—An inquest was held at Cambridge recently into the death of Daniel Holmes, a G.E.R. wireman. It was stated in evidence that the deceased was replacing telegraph wires and was at the top of a ladder about 20 ft. in height. There was 40 or 50 yards of slack wire on the ground, and this was evidently caught by a moving train, causing Holmes to fall. He was admitted to hospital with fracture of the left leg and right forearm. Septic poisoning affected the leg wound and he died shortly afterwards. A verdict of "Accidental death" was returned, the coroner remarking that no blame attached to the railway company.

On July 28th an inquest was held on Jesse Webb, of Brimington, who was killed by electric shock. The deceased was employed by the Staveley Coal & Iron Co., and, as he was about to commence work on the day of his death, he came into contact with a fallen cable, receiving a shock at 6,000 volts. The consulting electrical engineer to the company said that the cause of the wire's falling was a faulty insulator causing the wire to fuse and burn through. The insulators were for 11,000-V working. A verdict of "Accidental death" was returned.

A 33,000-volt Cable.—A few weeks ago we published some particulars of a 33,000-volt cable which is being laid at Birmingham. We have now received some information regarding a similar cable which Messrs. Johnson & Phillips, Ltd., are making for the supply of power at 33,000 volts to an important northern steel works. The cable (fig. 1) is designed for a

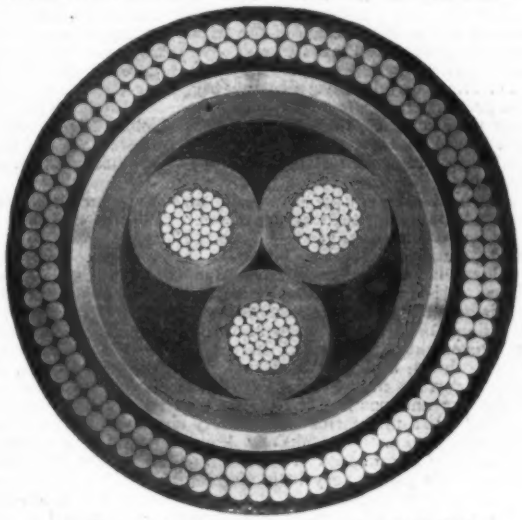


Fig. 1.—A 33,000-V Cable (about ½ actual size).

3-phase a.c. supply. The conductors are of .2 sq. in. section, the thickness of the paper insulation between cores is .5 in., and between cores and the lead sheath, .5 in. Over the lead is a bedding of compounded jute upon which .16 in. diameter galvanised steel armouring wires are laid. A further layer of jute and another set of wires are then put on, and the whole is finally served with jute yarn and heavily compounded. The weight of the complete cable is 72 lb. per yard.

Ball Lightning in London.—A description of ball lightning seen in the sky at St John's Wood during the thunderstorm in the early morning of June 26th has recently been received at the Meteorological Office. The phenomenon, a large incandescent mass floating in the air below the clouds, and apparently stationary for some minutes, is of great rarity, and the Director of the Meteorological Office, London, S.W. 7, would be greatly obliged if persons who observed it on this occasion would communicate with him.

U.S. Patents Law.—A Bill has been introduced in the United States Senate requiring foreign patentees to work their inventions in the United States within two years from the date of the issue to them of United States patents. Failure to conform will give the Government the right to license the invention to any person "for manufacture, use, or sale." About 1,200 British inventions are patented in the United States every year. Heretofore no British inventor possessing a United States patent has been required to work it in the States or pay any annual tax upon it during its 17 years' life.

The Federation of British Industries.—The Grand Council held its regular quarterly meeting at Prince's Restaurant, S.W., on July 20th. Sir Peter Rylands occupied the chair, and there was a large gathering of members present. The Fuel Economy Committee presented a report to the Council describing the progress of the scheme since it came into operation in September last. Mr. A. W. Chivers, acting chairman of the Committee, proposed, and Sir Robert Hadfield seconded, the adoption of the report. In the discussion which followed, one or two members raised the question whether this development of the F.B.I. activities might not lead to direct interference with the practice of established consulting engineers, and whether it really came within the normal scope of a body like the Federation.

The President said that this aspect of the question had been considered before the Department was set up. In his view fuel economy was a proper subject to be dealt with by the representatives of industry.

Sir R. Hadfield said the work of the Department was necessary. He felt that if the scheme were given support, it would be to the advantage of industry generally.

The report was unanimously adopted.

During the first six months' operations twenty-five separate inquiries were dealt with—many requiring personal investigation of plant—on behalf of firms consuming over 175,000 tons per annum. It is therefore recommended:—(*a*) That the activities of the Department should be gradually extended by development on the lines already laid down. (*b*) That the educational activities of the Department should become a more prominent feature, and the *Fuel Economy Review* should be produced quarterly as part of such development; and (*c*) As soon as the organisation is on a completely self-supporting basis, any excess revenue should be allocated to development upon lines already indicated.

Scandinavian Power Transmission.—A conference of representatives of Sweden, Norway, and Denmark will be held at Christiania in the third week in August to discuss the question of the proposed transmission of power from Norway to Sweden and Denmark.

Electricity in Medicine.—The so-called new cure for cancer was briefly mentioned during a lecture in the Radiology Section at the final session of the recent meeting of the British Medical Association at Newcastle-on-Tyne. For some time specialists have hoped that they could cure cancer if they could direct certain rays into the particular part of the body and persuade the affected tissues to absorb them. The difficulty was, however, to construct a tube capable of "shooting" such powerful rays without itself collapsing under the bombardment. It is now stated that this point has been largely overcome.

The *Newcastle Daily Chronicle* says that an interesting demonstration of electrical treatment for chronic otorrhœa by zinc ionisation was given at the Electro-Therapeutic Institute, Jesmond, by Dr. Alfred R. Friel, M.A., F.R.C.S.I., aural specialist, Ministry of Pensions (London District), and clinical assistant at the Royal Free Hospital, London. Ionisation is only suitable for specially selected cases of chronic septic conditions of the ear, nose, and throat, and the treatment has proved most beneficial. In the process the zinc solution is electrolysed, and by that means penetrates the tissues, the electric current in the case under notice being administered in the ear and passing out of the arm. Dr. Friel explained in detail what he described as the very simple technique of the apparatus, and with the aid of a boy patient gave a practical exposition of the process. It is mainly an antiseptic procedure, and as a rule causes very little discomfort. In a suitable case, he said, one treatment was sufficient to cure the often-neglected complaint of a running ear, and he instanced a case where one patient had been cured after 20 years' suffering.

A New Theory of Vision.—Prof. J. Joly, of the University of Dublin, has recently proposed a theory of colour vision, says the *Times*. When a ray of light reaches the retina, it sets free "photo-electrons" each of which contains a known quantum of energy determined by the frequency or wave-length of the kind of light to which its liberation is due. The electrons discharged by the red end, where the waves are long, have a small quantum of energy, but there is a continuous increase in the quantum towards the violet end, where the short waves liberate more energetic electrons. These electrons have an action like the pulling of a trigger on the rods and cones of the retina, releasing a store of energy sufficient to send a stimulus up to the brain. But trigger action is a hit or miss; the energy of the propelled bullet depends on the explosive charge, not on the pull. The rods and cones of the retina are known to be the receptor cells which receive the stimulation of light, and pass it on as a relayed message to the brain. Prof. Joly suggests a function for a known difference in their structure. Each rod is the starting-point of an extremely delicate thread which must be the channel of communication to the brain. Each cone has a stouter link with the brain, possibly consisting of a bundle of threads. He suggests that whatsoever be the quantum of energy in the electron which enters a rod, it can send only one kind of message to the brain. He supposes, therefore, that the rods are the apparatus by which messages of the presence or absence of light are received and transmitted, without distinction as to "colour." But electrons entering the cones can ring up two, three, or four of the fibres, according to their quantum of energy, and so send different kinds of messages corresponding with different kinds of light. By an elaborate physical argument he shows that quanta of energy would be excited in these proportions by the parts of the spectrum representing the three primary colours, red, green, and blue-violet, of the Young-Helmholtz theory. If he is right, the physical structure of the eye would thus account for the manner in which the sense of vision interprets external objects as displaying sharply marked colours.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The Times states that Mr. EVELYN CECIL, M.P., has left for Bergen, Christiania, Stockholm, and Copenhagen, in connection with the telephone inquiry, accompanied by Mr. W. W. Cook, M.Inst.C.E., the assessor to the Telephone Committee.

Mr. J. W. ROBERTSHAW, foreman of Messrs. W. & D. Wilson, contracting electrical engineers, Bradford, was recently elected from among 40,000 ex-Service men to receive the freedom of the city of Bradford.

Mr. A. S. BLACK, borough electrical engineer of Southport, has been selected by the Electricity Committee of Ipswich Corporation to succeed Mr. F. Ayton as borough electrical engineer there.

Wills.—The late Mr. A. H. KING, a director of Aron Electricity Meter, Ltd., the Aron Taximeter Co., Ltd., and other companies, left £25,741 net personalty.

Mr. G. E. TENNANT, a director of Messrs. E. Green & Son, Ltd., left £42,813 gross and £38,952 net personalty. £200 is left to the company for the income thereon to be applied to encouraging meritorious work among the staff and work-people.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Tofield & Robinson, Ltd.—Particulars of £8,000 debentures authorised June 17th, 1921: Whole amount issued; charged on company's undertaking and property, present and future, including uncalled capital.

Southern Electric Free Wiring Co., Ltd. (64,550).—Return dated January 14th, 1921. Capital, £5,000 in £1 shares; 1,510 shares taken up and paid for in full. Mortgages and charges: Nil.

Sterling Telephone and Electric Co., Ltd. (101,415).—Return dated April 5th, 1921. Capital, £65,000 in £1 shares (49,650 pref. and 15,350 ord.); 39,500 pref. and 15,350 ord. shares taken up; £24,500 paid; £30,350 considered as paid. Mortgages and charges: Nil.

Shanghai Electric Construction Co., Ltd. (86,795).—Return dated June 14th, 1921. Capital, £400,000 in £10 shares; 36,510 shares taken up; £317,000 paid; £48,100 considered as paid. Mortgages and charges: Nil.

Bath Electric Tramways, Ltd. (74,278).—Return dated May 19th, 1921. Capital, £230,000 in £1 shares (75,000 pref., 125,000 preferred ord., and 30,000 deferred ord.); 75,000 pref., 75,606 preferred ord., and 30,000 deferred ord. shares taken up; £150,606 paid; £30,000 considered as paid. Mortgages and charges: £147,517.

CITY NOTES.

Anglo-Portuguese Telephone Co.

Mr. Herbert Allen (chairman) presided at the annual meeting held on July 26th at Worcester House, E.C. He said that the company had had a serious setback in its fortunes, and for the first time for over 20 years it had to pay as small a dividend as 3 per cent. The year 1920 was one of great disappointments. It was characterised by acute commercial, financial, and political conditions in Portugal; by comparative inelasticity in their business, by a complete collapse of the currency of the country (which recently for exchange purposes had reached only one-tenth of its par value), and arising largely out of this, by an intolerable increase in wages and other working expenses. Innumerable instances could be given of the disastrous effects of the depreciated currency in almost every branch of their business, and when they came to deal with the balance of trading profit there was a disastrous loss on exchange. Another question of outstanding importance was that for all purposes they were entirely in the hands of the Government. They had to put up a hard fight for every concession. Their original tariff of 1901, although nominally in currency was practically on a gold basis, for the milreis or escudo at that time stood at about par. The various increases which they had obtained amounted in the aggregate to close upon 500 per cent., which meant that where they used to get 100 escudos they now got 600. But there was a vast difference—the escudo worth 4s. 6d. and one worth 6d. only, and as between the fall in

the escudo, the rise in their tariff rates in sterling was still only two-thirds of what it was originally. The result was that whilst there was a rise in their receipts from 491,908 escudos to 797,832 escudos, an increase of 60 per cent., there had been an increase of 180 per cent. in their expenses. The expenses went up from 262,849 escudos to 737,074. The result was a trading profit of 60,758 escudos, as against 229,000 escudos in the preceding year, and enabled them to pay a dividend of 3 per cent. There was some small provision for depreciation, but personally he was unable to say whether it fully met the requirements. What the whole situation amounted to, seemingly, was this: For a period of two years their wages had gone up ten to twelvefold, and materials three to fourfold, and any profit they made in currency could only be turned into sterling at about one-tenth its face value. Their only hope seemed to lie in the increased tariff which came into force a few months ago and an improvement in the exchange. So far as the exchange was concerned, there had been a slight recovery, but as to how far that was based on intrinsic value or on reported loans from America, he could not say. Perhaps the most striking feature of the business was the great increase in the expenses. The directors had particularly addressed their engineer on this point, and were assured that it was due to circumstances beyond the control of the company. He could say they were not overstaffed, and he was certain that was so so far as London was concerned. It was a little tantalising to all of them to read of the wave of prosperity on which so many of the telephone companies seemed to be riding, but they were not operating in Portugal, in which respect they were to be congratulated. There was not a single public utility company in that country which at present was paying its way. Railways, tramways, gas and electricity all appeared to be in the same boat, so that their own company was not alone in misfortune, if that was any consolation to the shareholders. The great bugbear was labour, and in most of the services he had mentioned the item of wages absorbed the entire gross income. Perhaps he had said enough about the past and they would like to hear a word or two about the future. Since the opening of the year, when the escudo was 6½d., they had had some wide fluctuations in the exchange. They had seen it as low as 4¾d. and as high as 9½d., and the last quotation was something about 7¼d. In January and for the first few weeks of February they worked under the increased tariff granted in 1920, and since February 21st they had had the benefit of a still higher tariff with wages the same. This should mean that at the present time there was a substantial margin between their revenue and expenses. He spoke with considerable diffidence as to the future, for he had no means personally of forming an opinion which he would care to air in public. He had, however, addressed many inquiries on the subject to the managing director and the technical officers of the company, with the result that some definite figures had been given him as to their trading prospects for the year. He need not trouble them with the details of the estimates, which were based on four separate rates of exchange, viz., 6d., 7d., 8d., and 9d., but he would give the broad conclusions: These were that with the rate of exchange at 6d. they would meet all their charges and have a surplus of about £35,000; at 7d., a surplus of £45,000; at 8d., nearly £60,000; and at 9d., close upon £70,000. He would not offer any opinion on the value of these estimates, but he was assured they had been prepared with the greatest care and on a conservative basis. Mr. Cook went further, and attributed the whole of their trouble (which he believed to be only temporary) to the lapse in the exchange and the interval between the time that the tariffs were increased. They had sufficient accommodation on their switchboards to meet requirements for the next three years, and 4,000 additional subscribers would mean about 30 per cent. of the present business of the company. It was a bitter disappointment to them that after 15 years of prosperous business the fates had turned against them. During those 15 years the lowest dividend they had paid was 6 per cent. in 1918. Once they paid 7¼, eight times they had paid 8 per cent., and once 28 per cent. From 1919 they had paid 7 per cent. Thus this was the lowest dividend they had paid in 20 years, and he could only hope that the recovery in their fortunes forshadowed in the estimates, or a substantial portion of them, would be realised.

Mr. J. E. Kingsbury seconded the motion, and emphasised several of the points in the chairman's speech. The report was adopted without discussion.

Chile Telephone Co., Ltd.

Presiding at the annual meeting, held in London last week, Mr. C. W. Parish said that owing to the unfavourable exchange, their revenue, collected in Chilean currency, showed a marked shrinkage when converted into sterling, and this adversely influenced the net results. According to the *Times* report, the speaker said that the business purchased in the Antofagasta district last year had been steadily progressing, and was being modernised and extended; and the work of preparing the lines for the new automatic plant about to be erected had been actively continued in Valparaiso. In spite of the set-back in the economic situation, due to stagnation in the nitrate industry and the trade depression throughout the world, Chile was ultimately bound to progress, and the board looked forward to the steady expansion of the company's business. Their concessions had recently been provisionally renewed for two years, and there was every reason to hope that the Chilean Government would give them such an extension of tenure as would be a sufficient guarantee to justify the directors in asking the shareholders to provide the additional capital required for future developments. In order to enable the company to counteract to some extent the loss on conversion of their currency receipts into sterling, they were arranging to charge a premium on their tariffs from October 1st next until such time as exchange improved to 10d.—a figure which the Government had agreed they were justified in taking as a minimum basis for the dollar. Señor Antonio Huneeus (chairman of the advisory local committee) was present at the meeting, and briefly addressed the shareholders. He believed that the Government would treat the company justly, and, at an early date, renew its concessions on reasonable terms.

Kalgoorlie Electric Tramways, Ltd.

Mr. A. H. P. Stoneham, presiding at the annual meeting last week, said that the net profits earned before charging depreciation were £8,742, against £7,040 last year. The car mileage had been reduced by 22,592 car miles owing to the heavy running expenses. The new mining development activity at Kalgoorlie had not come up to expectations. Business had been depressed owing to the heavy losses of speculators in the many new companies. It was possible that even now some of the new mines might turn out to be payable. The year had been one of difficulty for the tramways with increased expenses and strikes. The award of the Arbitration Court in regard to back pay did not bring that period of peace to which they looked forward, for as soon as the Arbitration Court granted the miners 16s. a day, the tramway employés applied for an increase to 17s. per day. An award of the local arbitrator had since given the men an increase of 2s. 4d. per day, but the Arbitration Court had reduced it to 1s. 2d., and it remained to be seen what the attitude of the men would be. For the first four months of this year the returns showed a decrease of £4,020 in receipts, and a decrease of £2,066 in operating expenses, the net revenue being £1,266 against £3,220, but for 24 days the tramways were not running.

Yorkshire Electric Power Co.

The directors report that the revenue for the half-year ended June, 1921, shows an increase over the corresponding period in 1920 notwithstanding the set-back caused by the three months' dispute in the coal-mining industry. After payment of interest, the net profits for the three half-years ended June 30th compare as follows:—1919, £19,229; 1920, £30,146; 1921, £28,283. Interim dividends will be paid upon the preference and ordinary shares at the same rate as last year, viz., 3 per cent. for the half-year. The time and thought of the officers of the company have been largely engaged upon the proposals of the Electricity Commissioners for the re-organisation of the area entrusted to the company. A public inquiry has already been held by the Electricity Commissioners at Leeds; a second and possibly a third inquiry is proposed to be held for other portions of the company's area and no decision has yet been announced. These inquiries involve a considerable expenditure of money and an interruption to the regular development of the company's business, but the directors hope that they may result in removing the legislative obstacles which have retarded the development of the company's undertaking. During the half-year considerable extensions have been made to the plant and mains which will enable the company to meet further demands from consumers who have contracted to take supply and will bring increased revenue during the second half of the present year.

Prospectuses.—*Producer Gas Plants, Ltd.*—The list was to close on August 3rd in an issue of 50,000 10 per cent. participating preference shares in this company, which manufactures a portable producer-gas plant, which can be fitted to any standard petrol-driven commercial vehicle without alteration to engine or chassis. The company began experimental work in 1917, but progress was stopped by the war.

British Automobile Traction Co., Ltd.—This Company has been issuing at par 200,000 cumulative 8 per cent. participating preference shares of £1 each. The company has been for many years operating motor omnibuses and motor coaches in various parts of the country. The dividends paid on the issued capital have ranged from 7 per cent. in 1913 to 10 per cent. in 1920, dropping for several years, the lowest being 4 per cent. in 1917. The offices are at the Electrical Federation premises in Kingsway.

Fullers United Electric Works, Ltd.—After deducting £6,678 for loss on realisation of investments and £13,333 for interest on short term notes, the accounts of Fullers United Electric Works for the year ended March 31st, 1921, show a loss of £129,408; £8,040 was brought forward, leaving a debit balance of £121,368. The amount reserved for excess profits duty—namely, £14,000—will not be required, and accordingly the directors propose to use this to provide for the depreciation of plant and machinery, and to apply the balance in writing off the experimental and development expenditure and £4,043 off preliminary expenses. The directors propose (1) to create and issue first mortgage debentures up to £150,000, and (2) to reduce the capital from £500,000 to £378,794 by writing off as lost 16s. per share on the 151,507 issued ordinary shares. —*Financial Times.*

Vickers, Ltd.—The directors announce the following interim dividends for the half-year ended June 30th, 1921:—2½ per cent. on the preferred 5 per cent. stock, less tax; 2½ per cent. on the 5 per cent. preference shares, less tax; and 2½ per cent. on the cumulative preference shares, free of tax. There are still outstanding questions of importance with Government Departments, chiefly the Inland Revenue and Admiralty, but until a settlement has been arrived at the directors are not able to complete the accounts for the year to December 31st, 1920.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 148a:—

Crompton & Co.—£20,000 six per cent. first mortgage debentures (registered), Nos. 1,251 to 1,450 (£100).

West India & Panama Telegraph Co.—£10,000 five per cent. debentures of £100 each, Nos. 801 to 900.

Hong-Kong Tramway Co., Ltd.—Interim dividend on account of 1921, of 1s. per share.

National Boiler & General Insurance Co., Ltd.—Interim dividend of 12s. per share, less tax, on ordinary shares.

Lanarkshire Tramways Co., Ltd.—Interim dividend at 5 per cent. per annum, less tax.

County of London Electric Supply Co., Ltd.—Interim dividend on the ordinary shares for the half-year ended June 30th at the rate of 5 per cent. per annum, less tax.

Electrical Distribution Co. of Yorkshire, Ltd.—Dividend on the ordinary shares for the June half-year at the rate of 6 per cent. per annum, free of tax.

Herbert Morris, Ltd.—Half-yearly dividends on the 6 per cent. (less tax) and 5 per cent. (free of tax) cum. pref. shares are announced.

Hart Accumulator Co., Ltd.—The directors recommend a dividend of 8 per cent., less tax, for 1920. The net profit was £24,022, plus £27,652 brought forward. After paying the dividend, £25,616 is to be carried forward.

Metropolitan Railway Co.—Interim dividend at the rate of 1¼ per cent. per annum on the ordinary stock, compared with 1 per cent. in 1920.

STOCKS AND SHARES.

TUESDAY EVENING.

THE quietest season of a quiet Stock Exchange year will be the week in which there fell the August Bank Holiday, and this must prove both excuse and justification for our "dropping into tables." It is inevitable, also, that this week should revive memories of the prices which ruled on the outbreak of war, seven years ago. In drawing up lists of comparative quotations at the present time, it is appropriate, therefore, to include what are available of prices which can still be matched against those of July, 1914. Some of those which would afford the most interesting comparisons do not lend themselves to such treatment, owing to the way in which share-capitals have been reorganised and readjusted. However, making what we can of the material at hand, the list of electricity supply shares affords a straightforward group that enables ready comparison:—

Share.	Dec. 31st, 1920.	Now.	Rise.	July 27th, 1914.
Brompton and Kensington ..	6	6	—	9½
Charing Cross	3⅞	4	+ ⅛	5⅝
Chelsea	3¼	3⅜	+ ⅛	4¾
City of London	1⅛	1 1/16	+ 1/16	—
County of London	7½	8⅛	+ ⅛	12
Kensington	3⅛	4⅛	+ ⅛	7½
London	⅞	1	+ ⅛	1 1/16
Metropolitan	2⅝	3⅜	+1	3½
St. James'	6¼	6½	—	9¾
South London	2⅜	2⅝	+ ⅛	3 1/16
Westminster	4½	5¼	+ ¼	8⅝

The Home Railway market is amongst the few departments of the Stock Exchange in which prices have remained obstinately flat over the past seven years. Underground Electrics, however, are amongst the stocks which, at times, have risen superior to their pre-war figures. How they stand now, this table shows:—

Stock or share.	Dec. 31st, 1920.	Now.	Rise or Fall.	July 27th, 1914.
Central Lon. Ass. Ord.	49½	49½	—	88
Metropolitan	20	27	—	37½
District	15½	19½	+3	21½
Underground Ord.	1½	2½	+ ½	2½
Ditto A	5/-	6/-	+1/-	7/6
Ditto Inc.	60½	77½	+17	88

Coming to the market in cable stocks and shares, exact comparison is vitiated in the Eastern issues by the fact that the four chief companies have raised money by the offer of new stocks at prices that gave proprietors a very handsome bonus. It is noteworthy that Marconis (where the capital has been largely increased) stand above their pre-war figure. Our representative list is as follows:—

Stock or share.	Dec. 31st, 1920.	Now.	Rise or Fall.	July 27th, 1914.
Anglo-American Pref.	75½	84	+ 8½	108½
Cuba Submarine	7	7½	+ ½	8½
Eastern Extension	14⅜	16⅛	+ 1¾	19½
Eastern Telegraph	169½	1 79½	+ 10	180½
Globe Telegraph Ord.	14⅜	16⅜	+ 2	11½
Great Northern	20½	23½	+ 3½	32½
Indo-European	80	80	—	80
Marconi	2 1/16	2 1/16	—	13⅜
United River Plate	5½	6	+ ½	6⅝
West India & Panama	1⅜	1⅛	— ¼	1½
Western Telegraph	14½	16½	+ 1½	19½

Manufacturing shares are difficult of comparison owing to the reasons set out in our first paragraph, and the table must perforce be limited to changes on the year:—

Share.	Dec. 31st, 1920.	Now.	Rise or Fall.
Babcock & Wilcox	2½	2¾	+¼
Brit. Aluminium ..	¾	⅝	—⅛
Brit. West. Pref. ..	1⅛	1⅛	+ ⅛
Callenders	1¼	1 5/16	+ 1/16
Elec. Construct. ..	⅛	—	— ⅛
Edison Swan ..	10/-	10/6	+6d.

Share.	Dec. 31st, 1920.	Now.	Rise or Fall.
General Electric ..	1⅜	1⅛	—¼
Crompton	16/6	15/-	—1/6
Henleys	1⅜	1 5/16	— 1/16
India Rubber ..	¼	¼	—
Siemens	1 1/16	1 1/16	+ 1/16
Telegraph Con. ..	21	20½	—½

Brazilian Tractions have fallen about 10 points since the end of last year. Anglo-Argentine 5 per cent. debenture has risen 7. Mexican Utilities proved a very erratic market during the period. Mexican Light & Power First Mortgage bonds at 77½ are 17 points to the good, and Mexico Tramways Firsts at 52½ are 14½ up. Possibly the main feature of the markets dealt with in this weekly survey is the manner in which new issues have been promptly subscribed. Good premiums rule upon most of the stocks and shares offered this year, and the demand is for more stock, owing to the fall of 2 per cent. in the Bank Rate since the year began.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1919.	Dividend 1920.	Price July 20, 1921.	Rise or fall.	Yield, p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	12	12	6	—	£10 0 0
Charing Cross Ordinary	7	8	4	+ ½	10 0 0
do. do. do. 4½ Pref. ..	4½	4½	8½	—	7 4 0
Chelsea	4	6	8½	—	9 4 8
City of London	18	14	1 1/16	+ 1/16	10 13 4
do. do. 6 per cent. Pref. ..	6	6	17/-	—	7 1 2
County of London	8	8	8½	—	9 17 0
do. do. 6 per cent. Pref. ..	6	6	8½	—	7 7 8
Kensington Ordinary	7	9	4½	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref. ..	6	6	2⅞	—	10 18 2
Metropolitan	6	7	3⅝	—	9 13 2
do. 4½ per cent. Pref. ..	4½	4½	5½	—	7 16 6
St. James' and Pall Mall	12	12	6¾	+ ¼	9 12 0
South London	6	7	2⅜	—	10 13 4
South Metropolitan Pref. ..	7	7	16/3	—	8 12 4
Westminster Ordinary	10	10	6⅜	—	9 6 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	84	+ 1	7 2 10
do. Def.	1½	1½	17	+ ½	8 16 6
Chile Telephone	6	6	5⅞	—	5 18 5
Cuba Sub. Ord.	7	7	7½	—	9 6 8
Eastern Extension	10	10	16¼	—	6 3 0
Eastern Tel. Ord.	10	10	169½	—	6 3 1
Globe Tel. and T. Ord.	10	10	16⅜	—	5 19 5
do. do. Pref.	6	6	9exd	—	6 11 6
Great Northern Tel.	22	24	33⅜	—	10 2 6
Indo-European	10	10	80	—	8 6 8
Marconi	25	—	2 1/16	—	—
Oriental Telephone Ord.	12	12	2 1/16	—	*8 16 8
United R. Plate Tel.	8	8	6	+ ¼	*6 13 4
West India and Panama	Nil	Nil	6/8	—	Nil.
Western Telegraph	10	10	16½	—	*6 1 2
HOME RAILS.					
Central London Ord. Assented ..	4	4	49½	—	8 1 8
Metropolitan	1¾	1¾	27	—	5 11 1
do. District	Nil	Nil	18⅜	—	Nil
Underground Electric Ordinary ..	Nil	Nil	2 1/16	— 1/16	Nil
do. do. "A" ..	Nil	Nil	6/-	—	Nil
do. do. Income ..	4	2	77½	—	5 3 3
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams, First Pref. ..	5½	12½	2⅞	—	10 0 0
do. do. 2nd Pref. ..	Nil	5½	2⅛	—	9 11 4
do. do. 5% Deb. ..	5	5	64¼	—	7 15 0
Brazil Tractions	Nil	Nil	28	— 1	Nil
British Columbia Elec. Ry. Pfce.	5	5	58	—	8 12 4
do. do. Preferred	5	4½	56½	—	*8 6 8
do. do. Deferred	8	6	55½	—	*10 16 2
do. do. Deb. ..	4½	4½	59⅜	—	7 2 10
Mexico Trams 5 per cent. Bonds ..	Nil	Nil	49½	—	Nil
do. 6 per cent. Bonds ..	Nil	Nil	23½	—	Nil
Mexican Light Common	Nil	Nil	9	— 2½	Nil
do. Pref.	Nil	Nil	17½	—1	Nil
do. 1st Bonds	Nil	Nil	77½	+3	Nil
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	16	2¾	—	6 14 6
British Aluminium Ord.	10	10	16/9	+3d.	11 18 10
British Insulated Ord.	15	15	1½xd	—	10 0 0
Callenders	15	15	1 5/16	—	10 8 8
" 6½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	15/-	1/3	13 6 8
Edison-Swan	10	—	10/6	—	—
do. do. 5 per cent. Deb. ..	5	5	68xd	—	7 7 1
Electric Construction	10	10	16/3	—	12 6 2
English Electric	8	8	12/6	—	12 16 6
Do. Pref.	6	6	15/-	—	8 0 0
Gen. Elec. Pref.	6½	6½	17/-	—	7 13 0
do. Ord.	10	10	2 1/16xd	—	*10 5 4
Henley	15	15	1 5/16	—	10 8 0
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India-Rubber	10	—	⅛	—	—
Met.-Vickers Pref.	8	8	14⅜	—	8 16 10
Siemens Ord.	10	10	13⅜	—	*8 13 2
Telegraph Con.	20	20	20½	—	*8 17 1

* Dividends paid free of Income Tax.

THE ELECTRICAL ENGINEERING TRADE IN SWITZERLAND.

For no less than 15 years prior to the war, the United Kingdom took fifth place in Switzerland's foreign trade. The factors which subsequently disturbed normal relations are described at some length in the report which has recently been issued by the Department of Overseas Trade from the pen of Mr. J. R. Cahill, formerly Commercial Secretary to H.M. Legation, Berne, and now Commercial Counsellor to H.M. Embassy, Paris.

The sound conclusion is drawn that judging even by recent results the Swiss market is worth more attention from the British manufacturer and merchant than it has so far received.

A country, although its population be under four millions, whose imports in 1919 and 1920 reached in value 3½ and over 4 thousand million francs respectively is important. Of these annual imports manufactured products represented 30 per cent., raw materials 36 per cent., and foodstuffs 34 per cent.

Mr. Cahill criticises British methods of appointing agents. He mentions instances of United Kingdom firms having their Swiss agents in Paris, Hamburg, Cologne, Frankfort, or Milan.

British products, notably iron and steel goods, enjoy a high reputation in Switzerland, and Mr. Cahill mentions one reason why a good opportunity exists at present to cultivate the market more closely. It is that the Germans are largely out of favour there. Firms which study Swiss requirements and grant liberal credit should profit at this juncture. The new Swiss import tariff, which has been introduced since Mr. Cahill's report was penned, does not hit British goods any more than those of our competitors.

Iron and Steel Trade.

The report mentions three special factors which have affected Swiss imports of British iron and steel goods, viz., high prices, the state of the exchanges, high indefinite prices, long or indefinite delivery. For example, there was an exceptionally strong demand for various British steel products required in the Swiss electrotechnical industry (*e.g.*, electrical steel sheets for transformers, steel for turbine blades) which enjoyed and enjoys the greatest prosperity, but requirements could not be met by British makers—in one case in fact only one-fifth part of orders were being supplied. In one or two cases in other Swiss industries the firms which preferred to obtain steel products from England and applied to the English market therefor, were eventually obliged to obtain them from Germany. In the last six months, however, it would seem that, principally owing to the exchange, Belgian, German, French, and Czecko-Slovakian exporters have been in a position considerably to undersell most British steel and engineering products, which do not happen to be definite British specialities. As regards the latter, Swiss orders are now being fulfilled without difficulty.

Swiss exports of electrical and other machinery showed some remarkable figures in 1920, *e.g.*, dynamos, &c., to Denmark (2½ million francs), Sweden (1 million), Norway (2 millions), Japan (1.1 million); also to Japan hydraulic and wind motors and pumps (2.6 millions), steam engines (2.5 millions), gas and oil engines (1.5 millions), and iron boilers (1.6 millions). Expansion of trade with Spain has taken place, especially in machinery (dynamos, 6 millions; hydraulic and wind motors, 3.2; milling machinery, 2.3; steam engines, 1.3; textile machinery, 1.2).

Water Power.

Mr. Cahill gives an interesting statement concerning the outcome of Swiss endeavours to develop her water power—a subject with which readers of the Review are generally familiar. These resources are officially estimated to contain a capacity of four million horse-power. One-fourth of this power is obtainable from her rivers, and the remainder from the lakes and streams in her mountains. At the beginning of 1921 a total of 171 works (of over 500 h.p.) had been erected or were in process of erection, whilst 190 works (of over 1,000 h.p.) had received, or had applied for, the necessary authorisation for construction. The following table supplies certain important data with regard to both groups:—

	Works built or building (of over 500-h.p.).	Works (of over 1,000-h.p.) for which authorisation received or applied for.
Number of works	171	190
Utilisable accumulation (in cubic metres)	417,790,070	2,467,681,000
Minimum power (net) ...	388,959	1,352,550
Maximum power (net) ...	1,587,770	4,527,100
Annual energy production in million kWh	352,186	10,986
Accumulation energy capacity in million kWh	315,030	1,877,339

Among the power stations already built, or building, are five with from 60,000 to 68,000 h.p.; one of 52,000; one of 48,600; three of 45,000; one of 42,000; one of 40,800; and ten of from 20,000 to 32,600; among the projected stations are fifteen of from 60,000 to 200,000, and eleven more of 50,000 to 55,000. There are now 18 large (*i.e.*, from 20,000 to 72,000 h.p.) power stations in operation, and the sole obstacle to the rapid execution of the bulk of the numerous schemes is the dearth of capital. At the present time about 26 per cent. of the estimated water-power resources of Switzerland have been turned to account; on January 1st, 1914, the power utilised was officially estimated at approximately 500,000 (or 12½ per cent.); at the beginning of 1920 there were in course of construction eight works with a total capacity of 400,000 h.p.

The linking up of the principal power stations, so as to provide mutual assistance and compensation in case of dearth or abundance of water power, has recently received serious consideration.

Last year the Swiss Power Transfer Co. (Schweizerische Kraftübertragung A.G.) was formed for the purpose of remedying the inequalities in power production (through shortage or irregularity of water supply) or distribution (through irregularities in demand, whether seasonal or daily). The majority of the works in Central and North-East Switzerland have become members of the concern, and it is hoped that those in French Switzerland also will shortly participate. Energy is already being distributed in many cases over distances up to 100 miles in Switzerland; in emergencies or in the event of unusual strain assistance is immediately obtainable from one or more stations by a system of telephonic control. Energy is also exported to Germany, France, and Italy under Federal li ...e.

Railway Electrification.

It may be again noted here that the Federal Railways have built or are building their own power stations. One reason generally given for this action is that the current of normal stations is generated as 3-phase, 50 cycles, whereas railway experience in Switzerland finds the single-phase, 16 cycle current is more suitable. At the present time, however, non-railway power stations also supply the railways.

The report closes with the following concise summary of the progress attained at the end of January last in the electrification of the Swiss Federal railways:—

I. *Sections whose electrification is completed*:

	Km.		
Since 1906, Brigue-Iselle	22		
Since July, 1918, Brigue-Sion ...	52		
Since July, 1918, Berne-Scherzligen	32		
Since Dec., 1920, Erstfeld-Biasca ...	90		
I. Total		196 km.	6.9%

II. *Section whose electrification is in course of execution*:

Date when electrification is expected to be completed:

May, 1921, Biasca-Bellinzone ...	20		
Jan., 1922, Bellinzone-Chiasso ...	55		
Jan., 1922, Erstfeld-Lucerne ...	60		
Jan., 1922, Goldau-Zoug	16		
Jan., 1922, Immensee-Rotkreuz ...	8		
Jan., 1923, Zoug-Zurich	29		
Jan., 1923, Lucerne-Zoug	28		
Jan., 1923, Sion-Lausanne	92		
II. Total		308 km.	10.8%

III. *Sections whose electrification will follow on above*:

By July, 1923, Lucerne-Olten ...	56		
By July, 1924, Olten-Basle	39		
By July, 1924, Lausanne-Vallorbe...	46		
III. Total		141 km	5.0%
Sum Total		645 km.	22.7%
Total length of the Swiss Federal Railway System		2,843 km.	100 %

Employers and Leadership.—Mr. William Graham, M.P. for Central Edinburgh, writing in the *Journal of Industrial Welfare*, is of opinion that there is substantial ground for the statement that the extremist suggestions which were true of the war period in industry and of the days immediately following the armistice, are being steadily discarded by the groups of workers to whom for a time they apparently appealed. In the midst of crisis there is recognition of the fact that only by strictly constitutional methods are far-reaching changes of a beneficial nature possible in industry and commerce. This being the case, it is exceedingly important that British employers should not lose so great an opportunity. There are many problems in which their leadership would be invaluable. Questions of working hours, wasteful methods, improved machinery, scientific management, and payment by results would be received far more favourably by the workers if it were shown that there is no system which does not lay down a minimum, that there is no reason why rate-fixing should not be a joint operation of employer and employed, and that even in a collectivist state, efficient methods would be essential to the popular welfare.

THE ENGINEERING CONFERENCE, 1921.

(*Continued from page* 130.)

Mechanical Advantages of Electric Locomotives compared with Steam Engines.

By Sir V. L. R. Raven, K.B.E., M.Inst.C.E. (*Abstract.*)

The mechanical limitations and disadvantages which exist in the steam locomotive and which are overcome to a very considerable extent by the adoption of electric traction may be briefly summarised as follows:—

The locomotive being a complete independent unit, its power cannot be greater than the capacity of its boiler. To increase the boiler capacity implies increased dimensions and weight, both of which offer grave difficulties with regard to clearances and strengthening of bridge structures. On many railways in Britain the limit of weight has been reached, and further development of power is only possible at enormous expense.

The boiler, cylinders, valve gear, crankshafts, and all reciprocating parts are costly to maintain. Turntables, fuelling plant, and water supply appliances must be provided. The cab is small and open to the weather, involving discomfort to the locomotive crew. The locomotive radiates heat and uses coal during many hours when it is doing no work, and the wear and tear of the locomotive on the track is considerably increased by the impossibility of accurately balancing the reciprocating parts.

The case for the electric locomotive may be set out by the brief statement that it is not hampered by any of the above-mentioned objections. In addition, it possesses other important qualifications such as:—

Simplicity of mechanical construction and operation. Increased power of acceleration. Higher scheduled speed due to the possibility of heavy short-period overloads resulting in more frequent service and increased use of existing tracks. Uniform turning effort resulting in better factor of adhesion at starting and on gradients.

Absence of all reciprocating movement and accurate balance of all rotating parts. Facilities for driving from either end of a locomotive. Accessibility of mechanical and electrical parts. Better accommodation for locomotive crew by reason of increased cab area and by closing in and heating the cab. Possibility of coupling two or more locomotives together under the control of a single driver.

The production of energy in a power station rather than on the locomotive leads to a very substancial economy of fuel. On a steam locomotive fitted with all modern improvements, it is not practicable to work at less than about 2¼ lb. of best quality coal per b.h.p.-hour, and very few engines are capable of doing this for any length of time; the average consumption is more like 3¼ lb. per b.h.p.-hour for passenger engines, and 5 lb. for goods engines.

With electric locomotives, whether passenger or goods, it is possible to reduce the consumption of fuel to 1¼ lb. per hour, or even less, of low quality coal per b.h.p. produced on the locomotives. In other words, electrification enables the fuel consumption to be reduced to one-half or one-third, the fuel employed being of a quality unsuitable for steam locomotives.

Experience with regard to the cost of repairs of electric locomotives working between Shildon and Newport, shows that this cost is approximately one-third that of maintaining the steam locomotives which worked this traffic previous to 1915. The difference in America is much greater, as Mr. Armstrong, chairman of the Electrification Committee of the General Electric Co., shows the cost of repairs per mile of three American railways varying from 6.3 to 14.6 cents, as compared with a cost of 60 cents per mile for a 2-8-8-2 Mallet steam engine, which is the class of engine that would have to be used to haul a similar train to that taken by the electric locomotive, the cost of repairs of which is 14.6 cents, or one-fourth that of the steam engine.

The following methods of driving are used:—

(*a*) Motor with reduction gear is the widely used method of transmitting the torque to the driving wheels; it is the ordinary double bogie articulated type, is widely used for freight traffic, and is the same as that used on the Shildon-Newport electrification, North-Eastern Railway, and others in the States and on the Continent.

(*b*) Quill drive secures all the advantages of a flexible gear in cushioning the transmission of torque, and lessens the vibration more effectively than the usual flexible gear construction and mounting. This drive is employed on the geared locomotives of the New York, New Haven, and Hartford Railway, also on the Chicago, Milwaukee & St. Paul line. Advantages of the quill drive are: (1) The driving wheels are large. (2) The centre of gravity of the locomotive is high. (3) The dead weight on the track is reduced to a minimum, consisting only of the wheels and axles, without the addition of any portion of the motors.

(*c*) Gearless motors are in use on the Chicago, Milwaukee and St. Paul and the New York Central Railways, and are giving every satisfaction. The advantages claimed for this design are: Simplicity of electric motor owing to the absence of motor bearings and gear, &c. Facility for examination of motor and removal of armature for repairs if required. The mechanical arrangement of the complete locomotive is said to possess the required flexibility and balance to enable it to run at any speed equally well in either direction without tendency to oscillate or spread the track.

(*d*) The principal advantage of the connecting-rod drive is that the exact position of the motor in relation to the driving wheels is at the disposal of the designer, and he is therefore free from the restrictions imposed upon him by the necessity for getting the motors into the space between the flanges of a pair of wheels, and is, therefore, enabled to use large motors and place them in the most convenient position in the locomotive. This method of driving has not been employed at all in this country, except for experimental purposes. In the United States there are a few examples, but on the Continent the connecting-rod drive is almost universal. Up to the present electrification in these countries has been carried out mainly on the single phase or 3-phase system, and Continental engineers consider that the additional complications caused by the introduction of cranks and coupling rods are more than compensated for by the advantage of having a free hand with the motor design. A large number of designs have been worked out. Some have proved quite satisfactory, others have given rise to a good deal of trouble. In most cases the trouble has been eliminated by strengthening up special parts such as crankpins, Scotch yokes, &c., and by introducing a certain amount of flexibility into the connections between the motors and the crankshafts.

Discussion.

Sir Vincent Raven's paper was discussed jointly by Sections VII and III on July 1st, Capt. H. Riall Sankey being in the chair.

Sir John Aspinall, in opening the discussion, said they had yet to learn which was the best type of electric locomotive for main line use, and he could not view with satisfaction the prospect of adopting the Continental design in which rotary motion was converted into reciprocating motion, and the latter was converted again into rotary motion; some form of direct drive through gear wheels was wanted. They must not expect to obtain results too rapidly; until all steam engines had gone they would not see the full advantage of electrical operation. He paid little attention to comparisons of coal consumptions; the figure to watch was the average consumption on the whole of the railways of the country. He looked forward to the use of electric locomotives on all the main lines of the country, and hoped to see one electric locomotive running from Aberdeen to Dover without a change. The problem of lubrication would need much attention, because engines would make long runs without a change, and it was essential that they should get the utmost mileage out of a locomotive before having to send it into the shops for repairs. The motors, &c., should be kept as high up in the cab as possible, above the bogies, dust, and dirt. Development had been retarded by the uncertainty about which system to adopt, but the Electric Railway Advisory Committee had recommended, and the Minister of Transport had approved, that there should be a uniform d.c. 1,500-V system with a third rail throughout the country.

Sir P. Nash was of the opinion that, while the advantages and economies of electric traction were striking and could not be ignored by the railway companies, at the same time wholesale electrification was neither desirable nor practicable. The time had come for serious deliberation before undertaking the conversion of main lines from steam to electrical operation. The electric locomotive had considerable advantages over the steam engine for the haulage of heavy loads, and it should be particularly useful in shunting yards by reason of its low stand-by charges. Experiments had indicated that 73 per cent. of a shunting engine's time was lost; it was standing for 43 and running for 57 per cent. of its time, but it only did useful work during 23 per cent. of its time. For yards which were not electrified a battery locomotive or tender would be applicable.

Mr. C. H. Merz explained that railway electrification had been delayed by the heavy capital expenditure it involved. Nevertheless, he was strongly of opinion that that would be compensated for by the economies that would thereby be brought about, *i.e.*, the saving in coal alone would be enough to pay for the electrification and, therefore, efficiency was of real importance. The great advantage of electric locomotives was that they were continuously available for service; they would run long distances, and for long periods, without needing to be overhauled. The delay in this country was due to the uncertainty about which system to adopt, but that had now been settled. While they had not yet reached finality there was certain standard equipment which could be adopted without fear with regard to financial or other results. At present the electric locomotive was a perfectly practicable machine, and he hoped railway engineers would not wait till they had produced a perfect machine before making a start, because it was only by experience with a variety of types over long distances that any great degree of perfection could be reached. The control equipment was not, however, what it might be; it was not creditable to electrical engineers and compared badly with the simple single-lever control of the steam engine.

Sir Philip Dawson pointed out that the author being a steam man, his advocacy of electric traction was all the more significant. He agreed that in a good many instances electrification could be undertaken now; nevertheless, Sir John Aspinall's vision of electric locomotives running from Aberdeen to Dover without change was optimistic. At the present time electric locomotives were by no means standardised, and he failed to appreciate the reason for introducing into them the difficulties that had been experienced with steam engines, *i.e.*, those involved by the use of connecting rods, the conversion of rotary into reciprocating motion, &c. Undoubtedly there was a great opening for electric locomotives in shunting yards where at present there was an enormous waste of time and money.

Mr. R. T. Smith explained that the international limits of industrial motors would have to be largely exceeded in the case of traction motors on account of the limited space into which the latter motors had to be placed. A traction motor should embody the latest advances made in the design of industrial motors, and for that reason they should be purchased in the open market, not built by the railway companies themselves. The locomotive industry of this country had been hampered by the railway companies building their own engines, with the result that British firms had no incentive to take up the manufacture of either steam or electric locomotives. Had the policy been different, he believed England would have made an equal position in the world in locomotive building as it had done in shipping. He hoped the same thing would not happen with regard to electric locomotives.

Mr. J. Dalziel said that a comparison of the tractive effort curves was strikingly in favour of the electric locomotive, and regeneration provided mechanical advantages which were greater than the electrical disadvantages. The Midland Railway was specially interested in the development of electric locomotives, because it had heavier gradients on its line than any other railway. The quill drive was good, and would suffice for the largest locomotives that would be needed in England. He regretted the possibility of the third-rail system becoming standardised in this country, because he believed overhead equipment could be put up at certainly no greater cost, it was specially suitable for sidings, and was the only means whereby a continuous system could be obtained so far as the equipment was concerned.

Sir Henry Fowler was convinced that main lines would be electrified considerably as soon as the financial position permitted, the reason being perfectly clear, namely, a higher efficiency could be obtained with electric than with steam traction. Some engineers had been frightened by the weight of electric locomotives that were used in the U.S.A., and it was true that a good part of the system might be put out of action by a breakdown at the generating station, but, generally speaking, finance was the deciding factor, for, however ingeniously steam locomotive engineers might go to work, they could never surpass the great fuel economies that were obtainable in a central power station. He would like to see the gearless type of locomotive adopted.

Sir Philip Nash could not allow it to be assumed that the third-rail system had been standardised by the Ministry of Transport. The fact was that the Electric Railway Advisory Committee had standardised direct current as being most suitable for this country, and it had suggested a pressure of 1,500 volts. The committee had not standardised—and it did not propose to standardise—the third-rail system for all purposes.

Lieut.-Col. F. A. Cortez Leigh thought that so long as shunting engines stood for 40 per cent. of their time, it was obvious that a large field existed for the use of electric locomotives. The latter engines had been known to run for ten days with hardly any attention at all, whereas he doubted whether a steam engine spent more than one-third of its twenty-four hours in actual running. Messrs. Armstrong had constructed a steam turbo-electric locomotive, which would shortly be on trial, which was expected to show very real economies.

Sir Vincent Raven, in reply to the discussion, explained that financial and economical considerations led him to believe in electric traction. Wages could not be reduced, but costs must be, and electric traction would assist them to do so, for they could cover the same mileage with 30 per cent. less locomotives, and so reduce both skilled and unskilled labour, and not consume any fuel when the engines were not doing useful work. They would have to do something of that sort if they intended to pay any dividends at all in the future. He fully appreciated Mr. Roger Smith's point, but his company had built its own electric locomotives for the simple reason that it could not purchase them anywhere outside. The necessary speed could not be got out of a single reduction gear. A steam engine could not be driven "all out," and its boiler needed careful nursing, whereas an electric locomotive could be driven for all it was worth, and on reaching the top of the gradient it was still as good as ever. They could build an electric locomotive 100 per cent. better than the present steam ones, and yet run it on the same permanent way.

THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

ANNUAL MEETING.

(*Continued from page* 164.)

Steam Raising.

By David Wilson, O.B.E., A.M.I.E.E.

(*Abstract.*)

The author divided his paper into three sections: "The Past, Present, and Future," and appealed for an endeavour to be made to put aside all self-interest and form an unbiased opinion of the true position; he well knows that progress in boiler design has been to a certain extent stifled by camouflaged reports. With all the experience available it should be possible for power station engineers to reach common ground on the more important points of boiler design and operation, and clear this ground for a real and effective advance, and a bureau of information should be established which would investigate differences of opinion and establish some definite lead. The contractor has to legislate for all, and owing to the lack of agreement on essentials, it is difficult to produce a standard boiler.

Efficiency.—It is necessary to consider efficiency in two sections: (1) Test efficiency, (2) operating efficiency. Regarding No. 1, it is established to the satisfaction of the author that when using a high-grade coal on a modern boiler constructed with a suitable proportion of heating and recuperating surface, a combined efficiency of boiler, stoker, superheater, and economiser equal to 85 per cent. of the net calorific value of the fuel can be obtained on test. Apparently quite reliable tests are on record showing an even higher efficiency.

Regarding No. 2, the big difference between test efficiency and operating efficiency is much greater than it need be, and the day is fast approaching when operating efficiency will approximate very closely to test conditions.

Load factor, with its resultant loss in "banked" fires, &c., is a serious difficulty, but we are perhaps inclined to attribute too big a drop in efficiency to poor load factor. With a good-quality free-burning coal it is quite possible to work boilers at very light loads and obtain high efficiency.

The good results obtained on test are not so much due to any expert knowledge possessed by the man in charge, as to the fact that he has facilities for maintaining absolute control over combustion. It means different staff arrangements and expenditure on instruments, but there can be no question as to the commercial possibilities in this direction, and there is already sufficient evidence from America, where college graduates are now employed in some stations in place of firemen, to show that it will pay to completely alter the status of the boiler house staff and supply all the scientific gear necessary.

With high-grade free-burning coal the results mentioned above are easily obtainable, but with low-grade coal they present difficulty.

Hence the selection and grading of coal should receive the utmost consideration from the station engineer.

Furnaces.—Furnace efficiency is the dominating factor at the present time. Hand-fired furnaces are still used, and when using high-grade low-volatile coal the furnace efficiency is not much less than in the case of mechanical stokers, but for bituminous coal mechanical firing is essential. Improvement in design of mechanical stokers has been such that they will burn practically any class of coal due to the more general application of "balanced draught," which is not a distinctive system, but simply means the intelligent use of forced draught. It means that with a given pressure under the grate the suction draught is reduced to the minimum amount necessary to lift the gases of combustion through the boiler flues—so that there is practically a balance in the furnace—the forced draught overcoming the resistance of the grate and firebed and completing combustion in the furnace. Whilst on the modern boiler there is no advantage in forced draught when using coal of average quality, it is often a necessity when burning very low-grade coals.

Regarding the best type of mechanical stoker to adopt, variable opinion is very often much more due to difference in conditions than to difference in design, and the variations in the coal are in turn due more to physical characteristics than to any difference in proximate analysis.

Concerning the talk about maximum combustion per square foot of grate, what we have to decide is the economical limit in this direction, irrespective of design—the range of fuel being a very important point, in view of the fact that engineers often now specify a stoker which will efficiently consume a variety of coals from coke breeze to the highly bituminous.

Maintenance costs go up in some proportion to the consump-

tion per square foot of grate. There is a limit to the maximum amount you can burn per square foot of grate, and if you install stokers of reduced size for such high consumptions, it means that normally you have to run the plant under forced conditions, leaving little margin for "boosting" in case of emergency. Again, it is more difficult to control efficiency at high rates of combustion. The station engineer should buy heating surface and grate area, but his specification requires very serious consideration, as engineers too often suggest conditions which never arise, and to meet such conditions the contractor will put forward plant which is not best suited for the average conditions. The engineer should have some fairly close idea as to the most suitable class of coal available for his station before deciding on grate area, and in order to cover different qualities of coal, it would be better to consider coal consumption on a basis of the B.th.u.'s liberated per sq. ft. of grate, rather than on the basis of lb. per sq. ft., and a figure of 350,000 B.th.u.'s per sq. ft. should be taken as a maximum for normal duty.

Modern boilers in this country are designed with sufficient combustion space for mechanical firing. The most prominent combustion expert in America does not attach very much importance to increased cubic capacity of furnaces, but attaches some importance to increased height. In reverberatory furnaces the height need not be so great as in the case of a hand-fired or other archless furnace.

It is difficult to imagine that any appreciable gain in efficiency will arise from adopting higher combustion chambers. The American Bureau of Mines determined, when burning Pocahontas, Pittsburg, and Illinois coals, that the combustion space worked out at 3.2, 3.9, and 5.8 cu. ft. of space per sq. ft. of grate respectively, when burning 40 lb. of coal per sq. ft. of grate per hour, which is equivalent to 12.5, 10.2, and 6.9 lb. per cu. ft. respectively. In the modern boilers installed in this country the combustion space under the tubes, excluding the combustion chamber proper under the arch, works out at about 6.1 cu. ft. of space per sq. ft. of grate area, and with a reasonable consumption of 25 lb. of coal per sq. ft. of grate, the consumption is 4 lb. of coal per cu. ft. of combustion space under the tubes.

Liquid Fuel.—The three main systems used for burning oil fuel are those in which (1) steam is used as a spraying or atomising agent; (2) air is used for this purpose; (3) the oil is atomised mechanically by pressure.

In practice, the first and third systems are those most generally adopted, the first on account of the greater simplicity of arrangement, and the last on account of its higher efficiency and greater applicability to higher rates of evaporation. Most burners designed to use steam will work equally well with air. The compressed air system is not more frequently used on account of the initial expense entailed in the installation of air compressors. Steam is frequently adopted on account of the low first cost of the equipment, and of its ready application to small furnaces. However, it is not an economical system from the output point of view, as usually about 5 per cent. of the steam produced from the boiler has to be used in atomising the oil, and this, in most cases, means a heavy cost for the make-up feed water. The actual efficiency obtainable with the steam burner is considerably lower than that obtained with compressed air, as a considerable amount of latent heat is wasted when steam is used. It is not suitable for large and important installations because of its want of efficiency and economy.

At present the system which takes the lead is that in which centrifugal force is the spraying agent, by delivering the oil through suitable orifices at a high velocity. This system is the most economical in actual working, and gives the highest efficiency of any, but its first cost is somewhat high, as it involves pressure pumps, heating the oil, and also filters are required to prevent any foreign matter choking the small orifices in the burners. There is no waste of feed water, and, as there is a closed circuit, oils can be used which are heavy and which cannot be dealt with in any other way, owing to the greater temperature to which the oil can be heated in a closed system.

Comparing the use of oil and coal is not purely a question of price per ton and the corresponding calorific values, as there is a considerable reduction in the cost of handling the fuel, and there are no ashes or clinkers to be carried away. Further, it is possible to work boilers at higher rates—that is, more steam per square foot of heating surface—with oil than with coal, although in relation to this point the draught conditions have to be most carefully watched in the design of the plant. Another important point is that the boilers are kept much cleaner over longer periods than when coal is used.

In large power houses at home there might be advantages in converting at least a few boilers from coal to purely oil firing, as with an oil-fired boiler peak loads can be met with ease, and in view of the possible reduction in the price of oil and its certainty of supply and constant quality, it is felt that the combined result would show a commercial saving.

Pulverised Fuel.—Seven systems have been tried in Europe during the past 30 years, and the subject must certainly receive the most serious consideration, but it will be some time before we can form a really definite opinion as to the value of pulverised fuel for our power stations.

Mechanical stokers have advanced to such an extent that many coals hitherto considered as refuse can now be used efficiently, and from a unit thermal efficiency point of view, it is not clear how it is going to pay to dry and pulverise high-grade coal, but the overall operating daily efficiency may be higher with pulverised fuel, owing to its flexibility; it should be possible to reduce standing losses, and it may be easier for the fireman to control combustion with varying grades of coal.

Size of Boilers.—The size of boiler has very little effect on unit thermal efficiency—in fact it is easier to control maximum efficiency on a boiler of moderate size than on one of the super-boilers now manufactured—and the selection of very large units is influenced chiefly by capital cost considerations and the possible improvement in overall daily working efficiency due to the reduction in the number of units and consequent lower radiation losses.

Steam Pressure.—In this direction Britain is ahead of America; 250 lb. pressure is quite common—several boilers are working at 350 lb., and at one installation boilers are now working at 475 lb. There is no difficulty in constructing boilers for any pressure likely to be demanded by the turbine contractor, and high pressures have little effect on the efficiency or operation of boilers. The evidence so far collected is that the maintenance on boilers of 350 lb. is no greater than on boilers of less pressure.

With first-class construction safety is not a matter of pressure, but of the general design of the whole plant.

Boiler Rating.—There is no difficulty in constructing boilers to work at high rating, but on account of increased maintenance charges American engineers are showing a decided tendency to lower the rating. It is quite misleading to talk of rating based on lb. of water evaporated per sq. ft. of heating surface, as this factor is influenced by different steam pressures and superheat, &c.; we must consider boiler rating on the heat transmission basis, and so put all comparisons on a common basis irrespective of different working conditions. The limit of the average rate of heat transmission through the heating surface of a water-tube boiler has not been arrived at, the practical difficulty of burning the fuel being reached long before there is any detrimental effect on the heating surface.

Air Heaters.—These are receiving a good deal of attention, but they are not going to make, by themselves, any serious reduction on the 7¼ million tons of coal used per annum by the electric power and lighting undertakings. There is very little, if any, reliable data on air heaters to indicate their real value, but by next year we may be in a position to give final judgment. The author is strongly of opinion that so far as boiler unit thermal efficiency is concerned, the air heater in lieu of a water economiser will not be a success.

Surplus and Waste Heat.—In future there will be considerable utilisation of surplus and waste heat for central power station work. This covers the supply of surplus gas from coke ovens and blast furnaces. In the Newcastle district the gas is brought some distance, and is burnt under water-tube boilers with an average efficiency for boiler, superheater, and economiser of about 79 per cent.

The Future.—The literal to-morrow indicates much more efficient results if scientific control of boiler plant is fully recognised and undertaken—not merely the buying of a few gauges, but the allocation of the best brains to the boiler house and orderly design. The margin between the best possible results and what may ultimately be obtained is very small. Final gas temperatures can now be reduced to a very low figure, and whilst further reduction is theoretically possible by, say, the adoption of a secondary economiser constructed of some material not liable to corrosion resulting from low temperatures and extended use of air heaters, capital cost considerations and other difficulties may prove that it is not worth the candle. Furnace design will continue to improve, and we shall be able to efficiently tackle any fuel which policy may decree to be the best from a national point of view.

On the day after to-morrow it may be forbidden to use raw coal for steam raising, and steps must be taken to recover the by-products before using the carbon residue. There is no difficulty in designing furnaces to utilise coke fuel, and many are in use to-day. Hot coke may even be discharged direct to the boiler furnaces, and experiments are being already started in this direction.

Boiler pressures may advance still further if turbine contractors call for it. Boilers are being constructed in this country for 1,000 lb. pressure now, but these are for process work abroad, and do not include drums in the ordinary sense of the term—the most difficult section to manufacture in large sizes. Superheat is not likely to advance much beyond the present maximum of 750 deg. F. final temperature. It is not expedient to subject the steel of which the superheater is constructed to higher temperatures.

In the future some effort will be made to obtain coal of at least more uniform quality, if not higher average quality, and station engineers should bring pressure to bear in this direction. With better coal selection, perfect supervision on the boiler house, complete equipment of all apparatus for controlling combustion, and the further possible small improvements in design, we can foresee the bulk of our electricity being generated at an efficiency of 18 per cent. instead of the present miserable average of about 10 per cent., but beyond that our vision fails so far as the steam generating plant as we know it to-day is concerned. As we scan the horizon we do not see anything which would suggest the dawn of any very radical departure in boiler design.

Boiler House Practice.

By W. M. Miles, A.I.Mech.E., F.C.S.

(*Abstract.*)

In the States and on the Continent attempts have been made with more or less success to purchase coal on a calorific contents basis, but consumers in this country have not fully realised the importance of this matter. The author holds that the usual method of selecting the most suitable fuel cannot be termed adequate, and even when a contract has been drawn up on a selected sample, the steps taken to ensure that subsequent deliveries are of equal quality are in many cases inefficient. Special attention is given to the subject of coal sizes, and in addition to the proximate or ultimate analysis, it is essential that the weights of each size should be given as a percentage, and all the slate should be picked out and also given as a percentage of the total weight of coal as shown in the original paper. Provided shale and slate are absent, the quality of coal deteriorates as the size diminishes, the greatest variation being with unwashed fuel, which, in the very small sizes, becomes more or less useless as a free burning coal.

Could a reasonable basis be established on analysis, size and suitability, between supplier and consumer, there is no doubt that a definite step towards economical generation of steam will have been accomplished. A standard method of analysis, taking calorific values, size of sieves for sampling, &c., should be drawn up.

There has been no general attempt to establish a penalised system of purchasing fuel in this country. The author has found the following method very suitable in this direction. In determining the net B.th.u.'s per penny, the calorific value of the coal as fired is multiplied by 2,240, and the product is divided by the contract price in pence per ton, plus one penny for each one per cent. of ash present.

For example, take a coal specified to contain six per cent. of moisture, seven per cent. of ash; B.th.u.'s dry, 13,000, and as fired, 12,220, price 25s. per ton delivered. Then one penny will purchase $(12{,}220 \times 2{,}240)/(300 \text{ plus } 7)$ equals 89,162 B.th.u.'s.

After finding the standard value in net B.th.u.'s per penny, future deliveries can be checked and allowed for as follows: Multiply the calorific value as fired by 2,240 and divide the product by the net B.th.u.'s standard, and from the quotient subtract one penny for each one per cent. of ash found to nearest unit. Assume that in future deliveries the calorific value as received was 11,900 and 12,500, and the ash 8% and 5.8% respectively, then the relative value of the coal would be as follows:—

(*a*) $(11{,}900 \times 2{,}240)/89{,}162 - 8.0 = 299 - 8 = 24/3.$
(*b*) $(12{,}500 \times 2{,}240)/89{,}162 - 5.8 = 314 - 6 = 25/8.$

The point aimed at is that the number of heat units purchased for one penny should always be the same.

The sampling and storage of coal, firebricks and refractories, feed-water treatment, corrosion in boilers, and condenser leakage are all dealt with briefly to indicate the best lines along which to work, and the author, being a Fellow of the Chemical Society, lays special stress upon the importance of providing sufficient instruments for testing purposes in the boiler house. He next takes up the subject of boiler-house management, and explains that during the recent coal economy campaign he gave a series of lectures to the firemen and firewomen employed in the various boiler houses, which led to an increase in the boiler efficiency, which averaged at the commencement 68.01 per cent. and gradually increased to between 73 and 74 per cent.

In America, special courses in fuel technology and practical firing are arranged for men who intend to take up this trade. Efficient results from these men should receive reasonable recognition.

To obtain and maintain efficiency it is essential to have reliable instruments, and also men trained to record their indications in a proper manner, and the author advocates the drawing up of standard sheets of requirements for tests.

With high-grade fuel, under normal working conditions, boiler efficiencies of 75% should easily be obtained, and where suitable instruments are installed and expert supervision given, possibly 77.5% for the combined efficiency of boiler and economiser without the effect of load factor being taken into consideration. Under test conditions efficiencies of from 80% to 83% varying with the grade of coal should not be hard to obtain, but if 82.5% is taken as standard when using high-grade fuel, the efficiency during normal running conditions with a good load factor should not be less than 77.5%, and with a poor load factor 75%. Comparatively good results can also be obtained by using inferior grades of coal under supervision, but as the losses in the ash and exit gases are greater than with high-grade fuel, a combined efficiency of 80% must be regarded as a satisfactory test figure. Too much must not be expected of the operating engineer, who already has his hands full. Investigations necessary for effecting any improvement should be undertaken by the staff of the testing department.

Provision should also be made, either by marine telegraph or other suitable system, for interpreting the various changes of load and plant in the engine room to the boiler house staff. A board showing maximum load in kilowatts, number of boilers steaming and banking, average kilowatts per boiler, &c., should be kept fully posted in the boiler house, to enable the engineer to give definite instructions.

The author has not put forward any opinion regarding different types of boilers, stokers, &c., but has confined his remarks to definite methods of effecting economy and efficiency in boiler-house working, and he gives many valuable practical hints.

Discussion.

Messrs. Wilson's and Miles's papers were read and discussed jointly on the second day of the meeting, when a hearty welcome to the home of the "Mechanicals" was offered to the Association by Mr. W. H. Patchell, vice-president of the Institution of Mechanical Engineers, who opened the discussion by advocating the use of large boilers. They received too many reports, and were afraid to speak the truth, whereas in the U.S.A. the working records were published week by week. He agreed with Mr. Wilson's remarks about power factor, but they must have large boilers which could be efficiently controlled. Heavy ash needed forced draught, and that encouraged air leakage in the boiler setting. Some of the latest American boilers had very large combustion chambers, and their lower drums were 21 or 22 ft. above the floor line. It was important to differentiate between the height of a combustion chamber and its mere radiation capacity; they must provide plenty of space so that complete combustion could take place before the gases reached the tubes. The amount of combustion per sq. ft. of grate area per hour was not taken into account in the U.S.A. The Ford Co.'s Ladd boilers stood 35 ft. above the floor line, and burned pulverised fuel, tar, oil, coke or blast-furnace gas; but, generally speaking, it was best to keep to one kind of fuel because the many variables prevented the best results being obtained with all. Harm would be done by burning oil in boilers which were not suitable for it. Pulverising plant required an enormous amount of space, but in some cases in the U.S.A. local grinders were placed above the boilers; the fuel was also highly explosive. Higher pressures seemed to be coming, but they would limit the size of boilers; it was time they adopted a uniform boiler test. Regarding Mr. Miles's paper, fusibility of the ash was the real thing, and small coals were not broken up large coal. It would do coal merchants much good if they would read the paper.

Mr. R. A. Chattock explained that he had been driven to burn oil at Birmingham to aid the poor coal which they had had to use, and which had reduced the boiler capacity by about one-third. The burners consumed about 100 gals. of oil per hour, but they damped down the poor coal, and it became difficult to ignite it. He then had small burners fitted on either side of the grate, consuming about 15 gals. per hour, so as to maintain incandescence and allow the poor coal to ignite. That example of the use of liquid fuel in an emergency might possibly be developed later on in cases where there was plenty of boiler capacity. The analysis of the fuel was of importance, because if there was more than 2 per cent. of sulphur in the oil, it would have a bad effect on the outside of the tubes. The use of oil in ordinary boiler settings might not do, as an ample combustion chamber was necessary to allow all the oil to burn before the gases reached the tubes.

Mr. S. E. Fedden pointed out that at Sheffield they ran at a boiler efficiency of from 73 to 75 per cent., including banked fires and week-ends. Automatic control apparatus cost money and needed skilled attention. Although at Sheffield it had paid, it would not always do to strain after the last degree of efficiency if coal became cheaper. As regarded pulverised fuel, trouble might be experienced by reason of the fine dust that was discharged from the chimney, although in France it had been suggested to him that such dust was beneficial as a fertiliser. So far he had only been able to ascertain that the saving resulting from the use of pulverised fuel was 1.44 per cent. as against mechanical stokers, a small enough figure compared with the large capital expenditure involved in installing crushing and drying plant. He welcomed Mr. Wilson's warning about high total temperatures because from the point of view of the materials it was unsafe to go too high. Regarding Mr. Miles's paper, half their troubles would vanish if they could buy coal and not dirt. It was a crying shame that coal was the only commodity that could not be purchased on quality, and the Association should be powerful enough to influence the coal owners. During the miners' strike he had used all sorts of rubbish, including coke dust and poor outcrop coal mixed with tar, at a cost of between £15,000 and £20,000 more than would otherwise have been the case, whilst the demand on his plant was halved. Oil could be burnt quite well in an ordinary furnace if the grate was covered with fire bricks, and the latter could be quickly removed when changing back to coal.

Mr. W. B. Woodhouse, in referring to the purchase of coal by specification and on a heat unit basis, said it was worth while to look at the subject from the coal owners' point of view. They were not buying a manufactured article, and if anything beyond a certain seam, size, and ash content was specified, the owners would have to safeguard themselves by increasing the price. One per cent. of ash meant a loss of 2 per cent. of the heat value in the coal; as the coal became smaller, the ash content increased up to a point, and then decreased as the coal became smaller still. He agreed that the fusibility of the ash was the important thing, and lamented the horrible practice of transporting dirt about the country.

Mr. W. M. Selvey endorsed what the previous speaker had said, and thought that the purchase of coal on a calorific value basis could not be enforced because of the knowledge, from the result of research, that coal was not a permanent substance; it was always oxidising and changing. Perhaps, how-

ever, the I.M.E.A. could try and arrange with the coal owners for fuel to be supplied in, say, three grades, to be known as power-station smalls, good washed, and good unwashed. Small coal was not big coal broken up; it was inferior and was cut from under the seam to facilitate the extraction of coal proper. The control of the boiler house was becoming so important that it was necessary to train men specially for it. He was not impressed with powdered fuel as a general solution of their difficulties.

Mr. Evans read some notes prepared by his managing director (Mr. Wood, of the Underfeed Stoker Co.), which pointed out that efficiencies of 85 per cent. had been exceeded; they were obtained now, but unknown to the operators of the plant. It did not follow, however, that a combination which gave high results under special test conditions would give the best results under ordinary working conditions, and in the hands of the ordinary operating staff. Therefore, their aim should be to provide equipment that would give the highest possible results under ordinary working conditions. Mr. Evans added on his own account that trouble was experienced in America from chimney dust; it might be of some value as a fertiliser, but he thought they could not use pulverised fuel in a residential area without encountering serious snags. The burning of coke breeze (made possible in London by the flexibility of mechanical stokers) and low-grade fuels generally would make a very great difference to the whole system of boiler-house economy.

Major Utting dealt with the subject of forced and balanced draught, showing that the maintenance of a correct balance was essential, but it was not always realised what that condition was. So far as the available scanty information went, it was difficult to justify the use of air heating on commercial grounds, because so much depended on the layout and design of other parts of the station than the boiler house. There was no need to dispute the author's figures, but at what cost would they be obtained? Could the use of heated air be advocated seriously? The direct saving resulting from air heating (between 4.7 and 5.2 per cent. as shown in a recent paper by Mr. Patchell) was not enough to guide them in the adoption or otherwise of the method. Combustion when pulverised fuel was used was assisted, however, by heated air.

Bailie Smith referred to the nuisance caused by chimney dust in the neighbourhood of plant burning pulverised fuel, and suggested that before engineers adopted new methods they should consider what their effects would be outside the generating stations. Why could not the dust be collected by means of electrical precipitation or some other method?

Mr. C. Smith said that the largest boilers in the world were now being erected in Paris; they were French made, and produced 132,000 lb. of steam per hour; the furnace capacity was roughly double that of the large Detroit boilers. The largest single-ended boilers had been constructed in England, and were now being shipped to the Shanghai municipal electricity works; they would burn Chinese slack dust, a very low-grade fuel.

Mr. Windle explained that engineers understood, but committee members did not, that small stations did not receive the amount of skilled attention that large ones did. It was, therefore, all the more necessary to provide gauges and recording instruments; at Doncaster last year an expenditure of £300 on instruments had enabled a saving of about 1,900 tons of coal, representing £3,000, to be made.

Mr. Mitchell was of the opinion that boiler-house instruments were justified, and boiler makers had erred in the past in not being in a position to advise their clients which were the best instruments to use. The Dalmarnock, Glasgow, boilers compared very favourably as regarded combustion space with large modern American boilers. Large combustion chambers helped to eliminate smoke, but little could be done in that direction in many of the Glasgow stations because the combustion chambers were much too small and the fuel varied so much. Glasgow drew its coal from 75 different collieries, and he had paid 2s. 6d. per ton extra for washed coal. It was questionable whether that expense was justified, but he thought it was. Large boilers gave better satisfaction in every way, and mechanical soot-blowers could be dispensed with in modern stations. Oil fuel had not been successful in many cases during the coal miners' strike because the conversion had been made in a hurried manner, and local heating resulted. He had used steam-flow meters for many years, and had found their accuracy good.

The authors replied briefly to some of the points raised, but reserved their full replies to the discussion for publication in the *Proceedings* of the Association.

(To be concluded.)

Gravesend Tunnel.—Mr. Alexander Richardson, M.P. for the division, arranged for the Minister of Transport to receive a deputation on August 4th with regard to the Gravesend tunnel scheme. The scheme is being supported by numerous firms along the line of the proposed connecting railway. The London Chamber of Commerce has the matter under consideration in committee, while the Baltic and the Port of London Authority have signified their approval of the construction of the tunnel.—*The Times.*

ELECTRICITY IN FACTORIES.

Report of H.M. Electrical Inspector.

The annual report of the Chief Inspector of Factories and Workshops for the year 1920 was issued last week.* The use of electricity in factories is reported on by Mr. G. Scott Ram, M.I.E.E., who records that the number of accidents reported during the year (394, of which 25 were fatal) was practically identical with that of the previous year; 18 out of the 25 fatal cases were due to shock from a.c. at low pressures, which is entirely in accordance with the experience of previous years. Although in most of these cases the systems were 3-phase, up to 440 volts between phases (the neutral point being earthed), the pressure of the shock would not exceed about 250 volts, as the contact was with one phase only, the victim being in connection with earth. In three of the cases the shocks were from lighting circuits taken from one phase and the neutral. The one fatality from d.c. at low pressure was not a case of electric shock, but was due to burns from an arc caused by a short-circuit at a switchboard. Of 20 high-pressure (2,000 volts to 11,000 volts) accidents reported, it is remarkable that only four had fatal results. The injuries in a number of the others were, however, very severe, some involving permanent incapacity. In 16 of the cases (11 of them in public supply stations) the injured persons were engaged in cleaning or other work on switchboards. Six were due to mistakes in switching, the sections of the switchboards on which work was to be done having been supposed to have been made dead. In five, work was deliberately undertaken close to unscreened conductors known to be live; one was due to a faulty arrangement of an interlocking device, and others were due to carelessness or forgetfulness.

The low and medium-pressure accidents were due to the usual varied causes, *e.g.*, non-earthing of metal work (four fatalities), handling of fuses of the non-protected type (two fatalities), contact with bare conductors, including trolley wires of cranes and furnace chargers (six fatalities). Many were due to faulty types of apparatus or inadequate protection and others to carelessness or ignorance on the part of the injured persons. Some accidents involving several fatalities were indirectly due to electricity, *i.e.*, failure of crane control and lifting magnets and the bursting of emery wheels of portable motor-driven grinders, due to excessive speed caused by failure of the shunt winding of the field circuit of the motor.

Amongst the "dangerous occurrences" reported, *i.e.*, accidents to plant not causing personal injury, were several breakdowns of turbo-generators. In one case both the turbine and generator of a 6,000-kW set were completely wrecked.

During his visits Mr. Ram found, as usual, numerous examples of bad work, such as have proved fruitful sources of accidents in the past.

Amongst the public supply generating stations visited were several which have been in operation for from 20 to 30 years and which have always been in an unsatisfactory condition. Badly located and badly designed in the first instance, without due regard to probable developments, when extensions of plant have become imperative, they have been put in from time to time without adequate extensions of buildings, thereby being unduly cramped. Old and out-of-date switchgear remains in use with extension panels added in inconvenient places, some at a distance from the original switchboards at which there was no room for extension and blocking access to other plant. The various cables are mixed up in a hopeless tangle. High pressure has been added in some, the switchgear being placed in most unsuitable positions. The plant is neglected, and everything is very dirty, with steam joints blowing. Naturally these stations are running at a loss, and they are very unsatisfactory from the safety point of view, and it has been difficult to get even small improvements carried out. The answer has been either that there is no money available or that it would be useless to spend money on patchwork improvements, seeing that a large scheme of alterations is in contemplation or even that it is expected shortly to substitute a new station. In one case the new station has been "in contemplation" for over 12 years, but appears to be as far from realisation as ever. It is to be hoped that under the new electricity supply schemes such stations as these will be scrapped and made into up-to-date sub-stations taking a bulk supply from elsewhere.

During the year Mr. Ram had the assistance of Mr. Lowe in the N.E. Division for the greater part of his time, and he has accomplished much useful work. The following are some extracts from Mr. Lowe's report:—

"Inspections during the past year throughout the division have revealed how great a contrast there is in the quality and safety of electrical plant in different works; much very poor and slovenly work is still being installed. In some cases it has been a question of cost, but not in all, and probably in the majority of cases lack of thought and care in the initial planning, and want of careful supervision and inspection during execution, are responsible. Frequently where the highest grade and most expensive apparatus has been purchased, the lay-out has been badly conceived and poorly executed, resulting in inefficient, inconvenient and dangerous plant. Among electrical contractors the requirements of the regulations still appear to be far from well known, and much

* H.M. Stationery Office, Kingsway, W.C. 2. Cmd. 1403; price 1s. 6d. net.

electrical plant which does not comply with the requirements of the regulations is being installed at the present time.

"Many firms, which have changed from steam driving to electrical driving, have placed their electrical plant in the sole charge of promoted millwrights and engine tenters, and appear to have implicit faith in the knowledge and judgment of such men regarding electrical matters, and allow them to carry out alterations and extensions. Although such men may be qualified to carry out routine operation duties, they have not the knowledge necessary for the detection and rectification of faults.

"As time passes it is easy to note the improvements, as regards reliability and safety, which are being effected in the use of electricity for different purposes. During the last year most excellent arrangements for the use of temporary electric lighting on board ships in course of construction have been noted."

Other inspectors have also done useful electrical work so far as their ordinary duties have permitted, notably Mr. Topham in the N.W. Division, Mr. Law (Sheffield), Mr. Lauder (Newcastle), and Mr. Bennett (Stockton).

Referring to Mr. Lowe's observations on unqualified persons being in charge of important installations, this practice is by no means uncommon. At a large engineering works which Mr. Ram recently visited in Scotland, and where over two hundred motors of various sizes up to 50 h.p. were in use on a 440-volt 3-phase supply, no electrical engineer was employed. The manager stated that he "did not believe in electricians," as he had tried them and found that they "really had nothing to do and were always messing about with the plant." Repairs, of course, had to be sent out. There was strong evidence in this case of the need of a proper electrical staff; in fact, the visit was paid on account of an accident which proved to have been due to the want of skilled supervision.

With regard to the practice of applying artificial respiration in cases of electric shock where the victim is rendered unconscious, there is still much ignorance on the matter on the part not only of factory employés and occupiers, but also of ambulance men and doctors who are called in. The importance of commencing the treatment at once and keeping it up for at least two hours, if the patient does not recover before that time, is not generally realised. During the year there were several cases where it was applied very soon after the accident and proved successful. In two cases of shock from 6,600-volt systems the patients came round in 20 minutes and two minutes respectively; in a 3,000-volt case, in 20 minutes; in a 2,000-volt case, in three minutes; in a 250-volt case, in 10 minutes. On the other hand, amongst the fatal cases, artificial respiration was continued in one case for over two hours, and in two others for over an hour unavailingly. In these cases, however, it was not commenced until several minutes after the accident. In some other cases it was continued for over half an hour. In three cases it was applied for less than half an hour "until the doctor arrived" and pronounced the patient dead, thus showing that the doctors in these cases were not aware of the necessity for continued efforts. In two cases no attempt was made to revive the victim, although one of them occurred in a large shipyard where an ambulance department was provided and one of the ambulance men was on the spot shortly after the accident. In order to bring the importance of this matter to the notice of the medical profession, a memorandum on the subject was issued by the Department in April and sent to all lecturers on forensic medicine in medical schools.

During the year nine prosecutions under Section 136, for breaches of the regulations, were taken. Two cases were dismissed and in others penalties varying up to £50 were imposed.

LEGAL.

J. Holbrook & Co. v. Court.

In the Mayor's and City of London Court, on July 26th, before Judge Jackson, a test case was tried in which plaintiffs, electrical engineers, 1, Foster Lane, Cheapside, E.C., claimed £69 3s. against Mr. H. J. Court, purveyor of meat and fish dealer, Whyteleafe, Surrey, for installing the electric light at his fish depot, butcher's shop, &c.

Mr. R. J. Sutcliffe appeared for the plaintiffs and Mr. Pocock for the defendant.

Mr. Sutcliffe said that the defence was that to induce the defendant to give the order, plaintiffs' representative, Martin, warranted that they had made the necessary arrangements with the Electric Supply Co. to put the cables in the road, and that they would be laid down within two or three weeks. Defendant gave the order on the faith of that representation which he said plaintiffs' representative fraudulently or recklessly made, and he had lost the whole value of the work. He counter-claimed for the sum claimed and £10 damages for the misrepresentation. Plaintiffs' case was that defendant gave the order for installing the electric light, and the work was done. Plaintiffs did not represent that the supply company would put in the mains either in two or three weeks or any definite time. Plaintiffs agreed to wire the defendant's fish depot for £9 15s., the butcher's shop for £24, the refrigerator and sausage-making machine, &c. The work was completed and plaintiffs did their best to get the supply company to supply energy to the village, but that had not yet been done. That was no reason why they should not be paid their account.

Defendant said that the plaintiffs' services were useless to him as the supply was not yet in the village because plaintiffs never got 15 consumers as arranged. Plaintiffs said three backed out.

The further hearing was adjourned until after the long vacation, Judge Jackson suggesting that the parties had better settle the case in the meantime. Plaintiffs' work might yet be very useful.

Brooks-Vos v. Purden, Ltd.

In the King's Bench Division on July 30th, Mr. Justice Bailhache had before him for further consideration an action in which Mr. Eugene Cornelius Brooks-Vos, of 147, Corporation Street, Birmingham, sued Charles Purden, Ltd., machinery and machine tools makers, of Lancaster Street, Birmingham, for the price of certain electric motors sold and delivered to the defendants. The case was partly heard at Birmingham Assizes in March. It appeared that defendants had refused to complete the contract or take further instalments of the goods on the ground that they were not of the horse power specified in the contract, and this was the main point at issue. His Lordship referred the matter to an expert, who now reported in the plaintiff's favour.

His Lordship, in giving judgment, said the goods had been wrongly returned by the defendant. The plaintiff would have judgment for the price of the instalment delivered, £573, but on the issue as to damages he found no damage had been suffered by the refusal of the defendant to take the balance of the contract quantity, and defendants would have the costs of that issue. The counter-claim would be dismissed.

Hazell v. L.C.C.

In the King's Bench Division on July 29th, Mr. Justice Bailhache heard this action, in which the plaintiff, a railway carman, sued for damages for personal injuries sustained in an accident at St. George's Circus, S.E. According to the plaintiff's case, while he was in charge of his van a tramcar belonging to the L.C.C., which had just been levered off a dead portion of the track, began running backwards, the controller having been left on, and the plaintiff suffered an injury to his foot.

Counsel for the L.C.C. took a point under Section 3 of the Public Authorities Protection Act, providing that in actions against public authorities arising out of matters done in the execution of their duty, proceedings must be begun within six months of the occurrence complained of. In this case, it was stated, the plaintiff was out of time in issuing his writ. Counsel, however, said that no doubt any representation of the Judge would be conveyed to the L.C.C., whose legal advisers, however, were bound to take the point.

Counsel for the plaintiff said he admitted the difficulty. His clients did not know the L.C.C. was relying on the point.

His Lordship said he thought the L.C.C. would be acting fairly if it allowed the plaintiff £120 in respect of his injury. He must, however, enter judgment for the L.C.C., with costs.

Obtaining Lamps by False Pretences.

At Bradford, on Friday last, James Edward Tatham (35), an electrician, was given six months' hard labour for obtaining by false pretences 183 electric lamps, twelve switches, and a "Plexsim" iron, valued in total at £42, the property of Mr. J. Dyson, electrical engineer, Bradford. It was stated that the prisoner went to Mr. Dyson, on various dates, and obtained the goods, saying they were for Mr. C. F. Metcalf, electrical engineer, of Halifax, who was a regular customer of Mr. Dyson's. On each occasion an invoice was given, but when a total invoice was sent to Mr. Metcalf ultimately it was found that the prisoner had no authority to get the goods. He had been employed by Mr. Metcalf, but was dismissed last March. It transpired in evidence that certain of the goods were sold by prisoner to a hardware dealer named Jowett, in the local market, Tatham representing himself to have just started business on his own account. It was stated that the prisoner was well-connected, but had lost two situations through drink.

A Big Norwegian Loan.—The Norwegian Hydro-Electric Nitrogen Co. (Norsk Hydro-Electrisk Kvaelstof A.S.) and its subsidiary hydro-electric works—the A.S. Rjukanfos—have concluded a loan for 50,000,000 kr. with a syndicate of Scandinavian and French banks, which are now offering the bonds for subscription up to August 20th at the price of 98 per cent. At present the plant in operation represents 345,000 h.p., and a further 100,000 h.p. is available for future use. The proceeds of the loan are for the purpose of increasing the working capital, which has become inadequate partly on account of the great increase in wages and the depreciation in money, and partly as a consequence of the production being devoted to a growing extent to the output of Norwegian nitrate.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Skyton-Jones, O'Dell and Stubbins, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

19,277. "Electric switches." A. A. G. Jensen. July 18th.

19,278. "Electrical apparatus for raising and lowering curtains, opening and closing doors, &c." E. Golland, W. Golland, L. Golland, T. Houghton, and Mackereth & Golland. July 18th.

19,310. "Electric arc regulating devices." E. P. Howell's, Ltd. (Howell's Cine Equipment Co.). July 18th.

19,318. "Electrically-heated boilers." E. Meystre. July 18th. (Germany, September 8th, 1920.)

19,326. "Coating for electric wires or cables." E. P. Brasse. July 18th.

19,328. "Selective switches for automatic telephone exchanges." G. Deakin and Western Electric Co., Ltd. July 18th.

19,345. "Electric switches." H. W. F. Ireland and H. Lucas. July 18th.

19,348. "Gas voltameter." Siemens-Schuckertwerke. July 18th. (Germany, September 4th, 1920.)

19,350. "Electrical control systems." R. Brooks and Metropolitan-Vickers Electrical Co., Ltd. July 18th.

19,351. "Master controllers for electrical control systems." Metropolitan-Vickers Electrical Co., Ltd., and N. E. North. July 18th.

19,352. "Electrical control systems." R. Brooks and Metropolitan-Vickers Electrical Co., Ltd. July 18th.

19,353. "Devices for raising and lowering trolleys in systems of electric traction with overhead conductors." R. Brooks, Metropolitan-Vickers Electrical Co., Ltd., and A. Priestley. July 18th.

19,354. "Electric traction." R. Brooks, Metropolitan-Vickers Electrical Co., Ltd., and A. Priestley. July 18th.

19,359. "Means for securing windings in electrical apparatus." Brush Electrical Engineering Co., Ltd., and P. W. Scholefield. July 18th.

19,369. "Rotary converters." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). July 18th.

19,378. "Electric lamps to be carried on the person." G. Oldham and J. Oldham. July 18th.

19,383. "Systems for generation and transmission of electric power." T. F. Wall. July 19th.

19,394. "Electrical condensers." T. F. Wall. July 19th.

19,411. "Electrical transmitter microphones." B. A. Pilkington and E. D. Young. July 19th.

19,414. "Trunk telephone device for conversion of single to double-bridge tests and *vice versa*." E. A. Beavis. July 19th.

19,433. "Electric relays." Metropolitan-Vickers Electrical Co., Ltd. July 19th. (United States, August 6th, 1920.)

19,444. "High-tension ignition apparatus for internal combustion engines." H. W. F. Ireland and H. Lucas. July 19th.

19,445. "High-tension ignition apparatus for internal combustion engines." H. W. F. Ireland and H. Lucas. July 19th.

19,450. "Electro-pneumatic braking apparatus." Westinghouse Brake and Saxby Signal Co. July 19th. (United States, March 17th.)

19,460. "Electrodes for arc welding and process for making same." W. H. Borne. July 19th.

19,468. "Obtaining tubes electrolytically." M. A. Jullien. July 19th.

19,476. "Means for production of electrical oscillations by choke coils or transformers." Ges. fur Drahtlose Telegraphie. July 19th. (Germany, July 21st, 1920.)

19,479. "Telephonographs, &c." Ges. Telegraphon. July 19th. (Germany, August 24th, 1920.)

19,493. "Electrical cables." British Insulated & Helsby Cables, Ltd., and W. P. Fuller and G. H. Nisbett. July 20th.

19,512. "Electric lamp holders." R. J. Berridge, L. W. Winnall, and E. H. Winnall. July 20th.

19,520. "Electrically heated appliances." C. W. Marriott. July 20th. (Australia, December 10th, 1920.)

19,527. "Electrically operated switchgear railway, &c., signals and points." E. W. Smith. July 20th.

19,528. "Electro magnets." E. W. Smith. July 20th.

19,539. "Electric generating plants or systems." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). July 20th.

19,540. "Rheostats, &c." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). July 20th.

19,543. "Electric distribution systems." British Thomson-Houston Co., Ltd. (General Electric Co.). July 20th.

19,586. "Renewal of filaments of thermionic valves for wireless telegraphy, &c." A. H. S. Colebrooke and W. A. Williams. July 21st.

19,588. "Spark plug testing set." W. M. Selwyn and J. Steel. July 21st.

19,591. "Internal shaping of clay in production of electric insulators." H. L. Doulton and H. Morris. July 21st.

19,636. "Electric couplings." A. L. Davis. July 21st.

19,637. "Electric switch boxes." A. L. Davis. July 21st.

19,647. "Electric railway control systems." Metropolitan-Vickers Electrical Co., Ltd. July 21st. (United States, July 30th, 1920.)

19,650. "Device for maintaining constant voltage in variable-speed dynamos." A. H. Traeger. July 21st.

19,660. "Drives for paper machines, &c." British Thomson-Houston Co., Ltd. (General Electric Co.). July 21st.

19,665. "Electric accumulators." A. Pouchain. July 21st.

19,681. "Operating mechanism for commutator of automobile engines." H. G. Crittenden. July 22nd.

19,700. "Process for production of metallic objects and for coating one metal with another by electro-deposition." S. O. Cowper-Coles. July 22nd.

19,712. "Electric alarms." A. W. Amos, A. L. Lloyd, G. E. Lloyd, and W. E. Lloyd. July 22nd.

19,723. "Renewal of electric incandescent lamps." M. Calderara. July 22nd. (Italy, March 3rd.)

19,727. "Directional wireless apparatus." C. K. Chandler. July 22nd.

19,734. "Electric device of the cartridge fuse type." A. de Gessler. July 22nd. (Germany, July 28th, 1920.)

19,738. "Electro magnets." H. Lacy. July 22nd.

19,744. "Electrolysis of solutions." Hooker Electrochemical Co. July 22nd. (United States, August 5th, 1920.)

19,752. "Feed-water heaters." British Thomson-Houston Co., Ltd. (General Electric Co.). July 22nd.

19,759. "Cooling electric transformers." Brush Electrical Engineering Co., Ltd., and P. W. Scholefield. July 22nd.

19,803. "Enclosed switch-fuse for controlling electric circuits." J. Cruwys, J. P. Keith, Power Equipment Co., Ltd. July 23rd.

19,808. "Electric terminal jaw punching." J. H. Hall and S. E. Hall. July 23rd.

19,814. "Supports for electric resistances." Credenda Conduits Co., Ltd., and F. F. D. Davidson. July 23rd.

19,830. "Dynamo-electric machinery." H. F. Joel. July 23rd.

19,833. "Electro-magnetic separators and extractors." H. Russell-Jones, W. E. Lawton, and C. E. Wood. July 23rd.

19,834. "Electro-magnetic separators and extractors." F. J. Gemmell, H. Russell-Jones, W. E. Lawton, and C. E. Wood. July 23rd.

19,840. "Electric signal apparatus." H. Wade (E. P. Severance). July 23rd.

19,853. "Adjusting device for electric meters, measuring apparatus, &c." New Antwerp Telephone & Electrical Works. July 23rd. (Belgium, July 24th, 1920.)

19,854. "Voltage coils for electric meters." New Antwerp Telephone and Electrical Works. July 23rd. (Belgium, July 24th, 1920.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

10,126. "Cooling of dynamo-electric machines." Vickers, Ltd., and A. B. Field. June 19th, 1918. (165,806.)

1919.

960. "Telephonic systems." E. A. Graham. January 14th, 1919. (165,814.)

7,456. "Telegraphic receiving apparatus." F. G. Creed and Creed & Co., Ltd. March 25th, 1919. (165,820.)

7,457. "Telegraphic receiving apparatus." F. G. Creed and Creed & Co., Ltd. March 25th, 1919. (165,821.)

7,848. "Electro-magnetic separation or concentration of minerals." W. M. Mordey. March 28th, 1919. (165,822.)

10,116. "Electrolytic cells." C. W. Marsh. April 23rd, 1919. (165,823.)

11,202. "Thermionic transmitting devices for wireless telegraphy and telephony." H. J. Round. May 5th, 1919. (165,824.)

16,491. "Magnetic chucks." E. C. R. Marks (Taft-Pierce Manufacturing Co.). July 2nd, 1920. (165,831.)

21,583. "Electric water heaters." R. Frister Akt.-Ges. December 9th, 1916. (132,258.)

1920.

264. "Electrical switches." Sir A. T. Dawson and Sir G. T. Buckham. January 3rd, 1920. (165,880.)

2,808. "Controlling electric instruments or apparatus by means of vacuum tubes." S. Brydon. January 29th, 1920. (165,888.)

2,919. "Electric switches." G. Comboni. January 30th, 1920. (Convention date not granted.) (138,866.)

3,220. "Electrically-operated relays for use with valve sets for transmitting wireless signals." A. K. Macrorie and G. Shearing. February 2nd, 1920. (165,889.)

3,568. "Electric lamp with luminous discharge." J. Pintsch Akt.-Ges. April 26th, 1918. (Addition to 135,485.) (138,642.)

3,809. "Method and apparatus for the electrostatic separation of materials." H. S. Hatfield and Imperial Trust for the Encouragement of Scientific and Industrial Research. February 7th, 1920. (Cognate application 31,242, 1920.) (165,892.)

6,369. "Electric incandescent lamps." F. A. Feldkamp. March 2nd, 1920. (165,901.)

6,414. "Sparking plugs for electrical ignition systems." A. Ogden. March 3rd, 1920. (165,903.)

8,438. "Electric switches." H. C. Hodges. March 22nd, 1920. (165,917.)

8,918. "Protective devices for electric circuits and apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). March 26th, 1920. (165,922.)

9,222. "Electric oscillation generators." Western Electric Co., Ltd. June 1st, 1915. (141,046.)

9,452. "Cooling of electrical apparatus." G. Schroeder. April 1st, 1920. (165,936.)

9,453. "Means for carrying off heat generated in electrical apparatus." G. Schroeder. April 1st, 1920. (165,937.)

9,487. "Magneto-electric machines." British Thomson-Houston Co., Ltd., and A. P. Young. April 1st, 1920. (Addition to 142,744.) (165,938.)

9,680. "Dynamo-electric systems for use on automobiles." British Lighting and Ignition Co., Ltd., and E. O. Turner. April 6th, 1920. (165,945.)

9,708. "Step-by-step mechanism for electric motor starters." A. H. Railing, C. C. Garrard, and W. Wilson. April 7th, 1920. (Addition to 139,889.) (165,947.)

9,801. "Electro-magnetic couplings." R. Erban. March 13th, 1919. (141,360.)

9,816. "Means for supporting porcelain or the like electric light fittings." G. P. Dennis. April 8th, 1920. (165,955.)

9,867. "Ventilating systems for dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). April 8th, 1920. (165,957.)

9,897. "Wireless signalling systems." H. J. Round and A. McLellan. April 8th, 1920. (165,959.)

9,974. "Dynamo-electric machines." British Thomson-Houston Co., Ltd., and F. P. Whitaker. April 9th, 1920. (165,961.)

10,184. "Thermo-electric systems for the production of electrical energy." E. B. Potter. April 12th, 1920. (165,970.)

10,188. "Vacuum tubes." Siemens-Schuckertwerke Ges. January 27th, 1917. (141,706.)

10,217. "Automatic telephony." L. Turcat. April 10th, 1919. (141,711.)

10,258. "Automatic telephone and the like systems." A. Labot. April 13th, 1920. (165,971.)

10,836. "Protective devices for electric circuits and apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). April 19th, 1920. (165,977.)

11,239. "Method of and apparatus for utilising an electric current to produce a modified current or a correspondingly modified magnetic flux." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). April 22nd, 1920. (165,985.)

11,240. "Apparatus for utilising an alternating current of a given frequency to produce an alternating current or alternating magnetic flux of a different frequency." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). April 22nd, 1920. (165,986.)

11,667. "Wireless telephony and telegraphy." H. L. Crowther, L. A. McDougald, H. Morris-Airey, and G. A. Irving. April 27th, 1920. (165,994.)

13,275. "Self-induction coils for telephone circuits." Soc. Industrielle des Telephones. May 22nd, 1919. (143,507.)

15,083. "Impulse transmitters for telephone systems." Siemens Bros. and Co., Ltd., and F. Baker. June 3rd 1920. (166,027.)

16,094. "Vacuum tube apparatus and method of controlling same." Marconi's Wireless Telegraph Co., Ltd. June 14th, 1919. (145,039.)

17,556. "Electric vehicles with storage batteries." A. Couallet. August 19th, 1919. (149,944.)

18,652. "Method and apparatus for radio signalling." Radio Corporation. January 6th, 1916. (146,528.)

19,335. "Telegraphy." Ges. fur Drahtlose Telegraphie. November 9th, 1916. (147,432.)

20,234. "Dynamo-electric machines for use on aircraft." Dr. E. F. Huth Ges., B. Rosenbaum, and K. Rottgardt. February 1st, 1916. (148,330.)

22,259. "Sparking plugs for internal combustion engines." M. P. Seneze. October 18th, 1919. (152,321.)

25,890. "Method of jointing cable." Western Electric Co., Ltd., and G. H. Nash. September 8th, 1920. (166,061.)

27,579. "Separators for the elements of electric storage batteries." Philadelphia Storage Battery Co. May 17th, 1919. (Divided application on 143,493.) (151,650.)

31,687. "Electric switches." G. F. Ostins. November 9th, 1920. (166,078.)

33,662. "Telephone apparatus for the deaf." E. C. Hansom. June 11th 1919. (154,536.)

1921.

346. "Switchgear for controlling electric motors." J. A. Hirst and P. S. Brook. July 10th, 1919. (Divided application on 155,614.) (166,084.)

613. "Electrodes for introducing medicaments in the human skin." W. Froese. May 16th, 1919. (166,637.)